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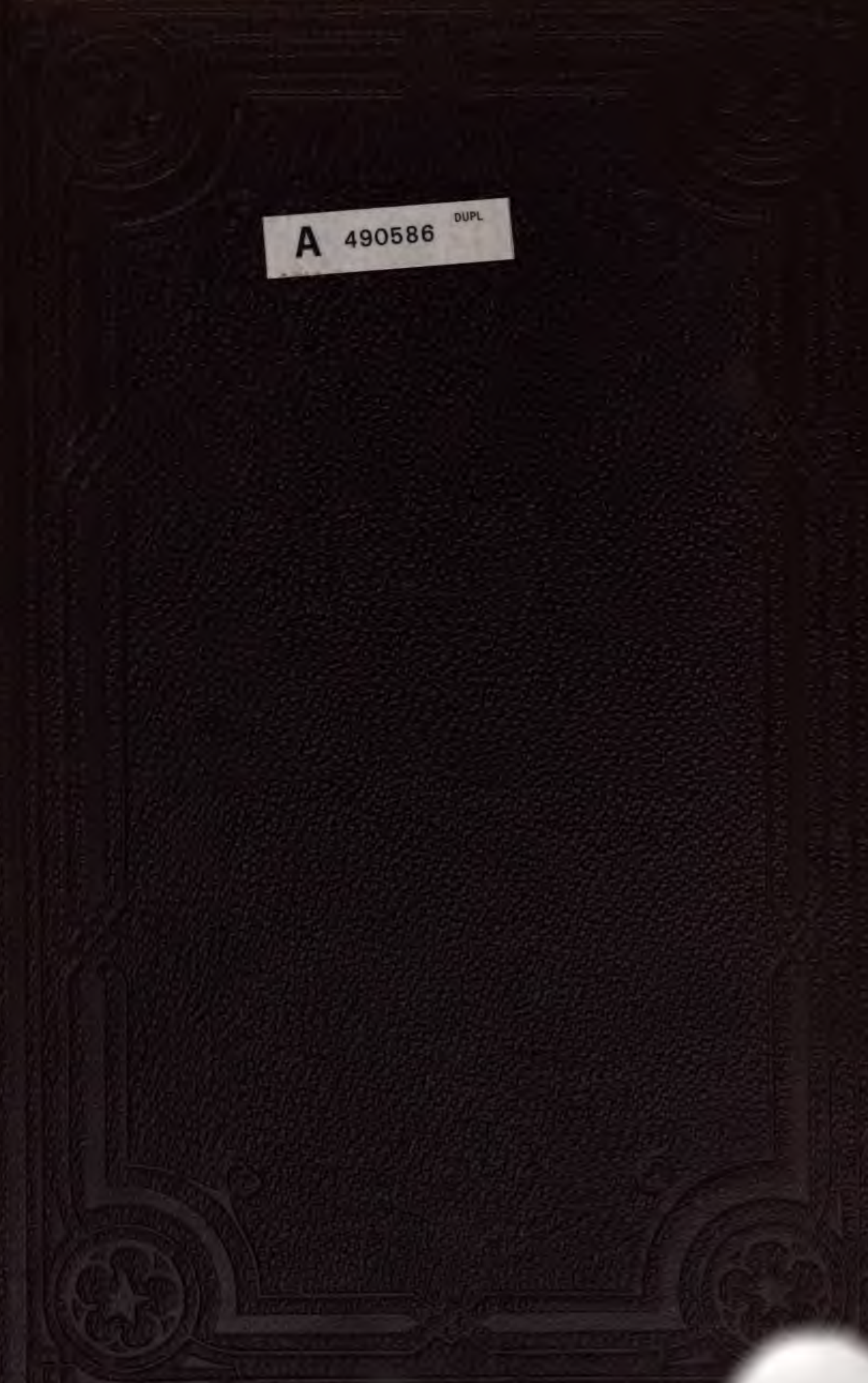

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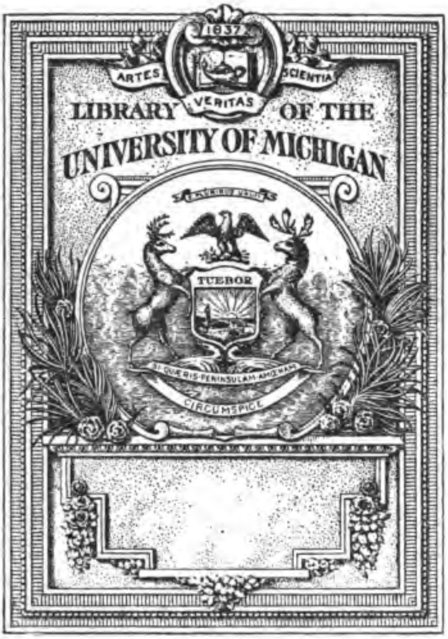

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LITERARY AND PHILOSOPHICAL SOCIETY

OF

LIVERPOOL,

DURING THE

SEVENTY-SECOND SESSION, 1882-83.

No. XXXVII.

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CORRECTED TO SEPTEMBER, 1883.

Life Members are marked with an Asterisk.

Oct. 21, 1872	Abbott, Joseph, B.A., 2, *Picton-street, Wavertree-road.*
March 24, 1879	Alexander, William, M.D., 102, *Bedford-street South.*
Nov. 1, 1880	Allen, Francis B., 58, *Kremlin Drive, Stoneycroft.*
Nov. 12, 1877	Allman, G. W., 4, *Ullet-road, Prince's Park.*
March 7, 1864	Archer, F., B.A., Trin. Col., Cantab., *Boundary Cottage, Little Crosby.*
*Nov. 28, 1853	Archer, T. C., F.R.S.E., F.R.SS.A., Director of the Industrial Museum, *Edinburgh.*
Nov. 29, 1880	Armour, Rev. S. C., M.A., Merchant Taylors' School, Crosby.
Nov. 13, 1876	Ball, Geo. Hy., *The Priory, St. George's Mount, New Brighton.*
April 20, 1874	Barton, Rev. John, M.A., *Vicarage, Rainhill.*
Oct. 21, 1878	Beasley, Henry Charles, 20, *Chesnut Grove, Wavertree.*
Nov. 15, 1869	Beer, Joseph B. de, *Northern Assurance Chambers, Tithebarn-street.*
Feb. 22, 1875	Bellew, Thomas A., *Cunard Mail Office,* 2, *Water-street.*
Nov. 15, 1875	Bellis, William, *Sunny Bank, Victoria Park, Wavertree.*

Jan.	27, 1879	Beloe, Charles H., *Lezayre, Livingston Drive, Sefton Park*, and 18, *Harrington-street.*
Dec.	10, 1866	Benas, Baron Louis, *Imperial Chambers, Dale-street.*
Jan.	9, 1882	Benas, Phineas A., 74, *Upper Parliament-street.*
Nov.	27, 1865	Biggs, Arthur Worthington, 28, *Exchange-street East*, and 11, *Percy-street.*
Feb.	6, 1872	Biggs, John H. W.
Feb.	6, 1882	Birchall, Charles, 32, *Castle-street.*
Jan.	25, 1864	Birchall, James, *Kirkdale*, Hon. Secretary.
March	9, 1866	Blood, William, *Chamber of Commerce*, and 47, *Hamilton-road, Birkenhead.*
Dec.	16, 1878	Bogue, Robert Lachlan, *The College, Shaw-street.*
Feb.	18, 1878	Bouch, John, 28, *Berkeley-street.*
Oct.	19, 1868	Bower, Anthony, *Vauxhall Foundry*, and *Bowersdale, Seaforth.*
Oct.	21, 1872	Bowring, C. T., *Elmsleigh, Prince's Park*, and 20, *Lancaster-buildings, Tithebarn-street.*
Feb.	6, 1882	Bradley, A. C., M.A., Professor, University College, Liverpool, 118, *Canning-street.*
Nov.	4, 1867	Bramwell, Ed., *Cowley Hill, St. Helens.*
Dec.	15, 1873	Brass, Joseph, M.D., 6, *Upper Parliament-street.*
Jan.	27, 1873	Bremner, H. H., 15, *Lord-street.*
Oct.	30, 1882	Brook, R. G., *St. Helens.*
Nov.	12, 1866	Browne, Edgar A., 86, *Bedford-street South.*
Oct.	18, 1869	Brown, J. Campbell, D.Sc., F.C.S., Professor of Chemistry, University College, Vice-President.
Oct.	30, 1876	Bulman, Richard, 18, *Chapel-street.*
April	18, 1864	Burne, Joseph, *Royal Insurance Office*, 1, *North John-street.*
Oct.	17, 1881	Burton, Dr., 64, *Rodney-street.*
*May	1, 1848	Byerley, Isaac, F.L.S., F.R.C.S., *Seacombe.*
Nov.	3, 1862	Cameron, John, M.D., M.R.C.P., Physician to the Southern Hospital, 4, *Rodney-street.*
Jan.	9, 1865	Cariss, Astrup, *Orange-court, Castle-street.*

Nov. 13, 1876	Carson, Thomas, M.D., 322, *Upper Parliament-street.*
March 4, 1872	Carter, W., M.D. Lond., 74, *Rodney-street.*
Dec. 2, 1861	Chadburn, William, 71, *Lord-street.*
Oct. 30, 1882	Clarke, John R., 25, *Nile-street,* and 5, *St. George's Crescent.*
Oct. 18, 1869	Cook, Henry James, *Byrom-street.*
Feb. 7, 1881	Cornelius, F. W., *Park House, Waterloo.*
Dec. 13, 1875	Cowell, Peter, *Free Library, William Brown-street.*
Oct. 6, 1863	Crosfield, William, 3, *Temple-court,* and *Alexandra-drive, Ullet-road.*
Oct. 17, 1881	D'Arcy, Nicholas P., *Custom House.*
Nov. 28, 1881	Danger, William, *Orange-court, Castle-street,* and *Liscard Park, Liscard.*
Nov. 12, 1866	Davies, E., F.C.S., F.I.C., *The Laboratory, Royal Institution, Colquitt-street,* PRESIDENT.
Oct. 1, 1866	Dawson, Thomas, 26, *Rodney-street.*
April 6, 1874	Dodd, John, *Cable-street,* and 2, *Derby-terrace, Rock Ferry.*
Nov. 3, 1879	Dopson, Daniel, L.D.S., R.C.S.I., 4, *Oxford-street.*
Jan. 22, 1883	Dowling, Jas., (P. S. Levy,) 24, *North John-street.*
Nov. 1, 1875	Doyle, Jas. F., 4, *Harrington-street,* and *Merton-road, Bootle.*
Jan. 23, 1848	Drysdale, John James, M.D.Edin., M.R.C.S. Edin., 36, *Rodney-street,* EX-PRESIDENT.
*Nov. 27, 1848	Edwards, J. B., Ph.D.Gies., F.C.S., Professor Medical Faculty of Bishop's College, *Montreal.*
March 21, 1870	Edwards, Edward E. (Smith, Edwards & Co.), *Adelaide-buildings,* 4, *Chapel-street.*
April 7, 1862	English, Charles J., 26, *Chapel-street,* and 26, *Falkner-square.*
April 20, 1874	English, Robert A., 26, *Falkner-square.*
Nov. 14, 1881	Evans, Geo. Eyre, 100, *Camden-street, Birkenhead.*

*Dec. 13, 1852 Ferguson, William, F.L.S., F.G.S., *Kinmundy House, near Mintlaw, N.B.*

Nov. 15, 1875 Fleming, E. L., F.C.S., *Borax Works, Old Swan.*

Oct. 1, 1866 Fletcher, Alfred E., F.C.S., H.M. Inspector of Alkali Works for the Western District, 5, *Edge-lane.*

*Mar. 19, 1855 Foard, James Thomas, 3, *Harcourt-buildings, Temple, London, E.C.*

Nov. 16, 1874 Fothergill, Charles George, 41, *Rodney-street.*

Jan. 12, 1874 Frost, John Pownall, 10, *North John-street.*

Nov. 12, 1877 Galley, Jno., 8, *Newstead-road.*

Nov. 29, 1875 Gardner, William, *Ash Lea, Oak Hill Park.*

Nov. 13, 1882 Gardner, Willoughby, 18c, *Exchange-buildings.*

Nov. 26, 1877 Gatty, Charles T., Mayer Museum, Free Public Museum, *William Brown-street.*

*Feb. 6, 1854 Gee, Robert, M.D.Heidelb., M.R.C.P., Lecturer on Diseases of Children, Royal Infirmary School of Medicine; Physician Workhouse Hospital, 5, *Abercromby-square.*

March 20, 1882 Gill, James, *Sailors' Home*, and 2, *Beech-mount, Beech-street.*

Oct. 20, 1879 Gracey, Robert, F.C.S. (Messrs. Gracey Bros. & Co), 70, *Great George-street.*

Oct. 29, 1877 Green, Robt. Frederick, 66, *Whitechapel.*

Nov. 14, 1858 Greenwood, Henry, 32, *Castle-street*, and *South Lawn, Great George's-road, Waterloo.*

Nov. 16, 1874 Grindley, Benjamin H., *Albion Office, School-lane.*

Nov. 16, 1874 Guthrie, Malcolm, J.P., 2, *Parkfield-road.*

Jan. 22, 1855 Hakes, James, F.R.C.S., 30, *Hope-street.*

Oct. 18, 1875 Hale, Philip A., Bank of England, *Castle-street.*

Oct. 21, 1872 Halliwell, Joseph, 10, *College-lane.*

*Jan. 21, 1856 Hardman, Lawrence, 35, *Rock Park, Rock Ferry.*

Dec. 13, 1875 Harpin, E., 46, *Onslow-road, Elm Park, Fairfield.*

Nov. 30, 1874 Harvey, Henry, M.B., *High-street, Wavertree.*

Feb. 6, 1865 Hassan, Rev. E., 2, *Olive Mount*, *Wavertree.*

Nov. 13, 1865 Hayward, John Williams, M.D., 117, *Grove-street.*

Feb. 6, 1865 Hebson, Douglas, 13, *Tower Chambers*, and 58, *Bedford-street South.*

Oct. 16, 1882 Herdman, W. A., D.Sc., F.L.S., F.R.S.E., Professor of Natural History, University College, 65, *Grove-street.*

March 7, 1880 Hess, Leonard O., 51, *Bedford-street.*

Nov. 4, 1872 Hicks, John Sibley, L.R.C.P., 2, *Erskine-street.*

March 22, 1869 Higgin, Thomas, F.L.S., 33, *Tower-buildings*, and *Huyton*, VICE-PRESIDENT.

Dec. 28, 1846 Higgins, Rev. H. H., M.A.Cantab., F.C.P.S., *Rainhill*, EX-PRESIDENT.

Jan. 13, 1879 Higgins, Henry Longuet (Messrs. Simpson & North), 3, *Water-street.*

*Oct. 31, 1836 Higginson, Alfred, 135, *Tulse Hill*, *London.*

Feb. 18, 1878 Hilton, Benjamin H., Crown Life Assurance, 5A, *Exchange-buildings.*

Oct. 30, 1882 Hindley, Henry N., *Sandon-terrace*, *Upper Duke-street.*

Nov. 16, 1863 Holden, Adam, 48, *Church-street*, and 2, *Carlton-terrace*, *Milton-road.*

March 9, 1868 Holme, James, 10, *Huskisson-street*, and *Eldon Chambers*, *South John-street.*

Nov. 30, 1874 Holme, Rev. Arthur P., *Tattenhall*, *near Chester.*

*Dec. 14, 1862 Holt, Robert Durning, 6, *India-buildings*, and 29, *Edge-lane.*

April 9, 1877 Hooper, Richard Bennett, 6, *Loudon Grove*, *Huntington-street*, *North Hill-street.*

Nov. 4, 1878 Howie, J. Muir, M.B., *Rodney-street.*

March 10, 1879 Hughes, John W., *Hornby-road*, *Wavertree.*

Jan. 24, 1876 Hughes, Lewis, 38, *St. Domingo-vale*, *Everton.*

Feb. 20, 1882 Hunter, Hugh, 25A, *Duke-street.*

*Nov. 13, 1854 Hunter, John, Member Historic Society, Pennsylvania, *Halifax*, *Nova Scotia.*

*April	29, 1850	Ihne, William, Ph.D.Bonn, *Villa Felseck, Heidelberg*, EX-PRESIDENT.
Oct.	19, 1874	Imlach, Francis, M.D., 16, *Canning-street.*
Jan.	26, 1863	Johnson, Richard C , F.R.A.S., 22, *Queen buildings*, *Dale-street*, and 19, *Catherine-street*, HON. TREASURER.
Oct.	21, 1878	Johnson, John Hampden, 22, *Queen-buildings*, 11, *Dale-street.*
Dec.	15, 1879	Johnson, Stuart M., 79, *Hutchinson-street.*
Feb.	24, 1868	Jones, Charles W., *Field House*, *Wavertree.*
*April	4, 1852	Jones, Morris Charles, F.S.A., F.S.A.Scot. *Gungrog*, *Welshpool.*
Oct.	18, 1869	Jones, William Bolton, 20, *South Castle-street.*
Oct.	21, 1878	Ker, R. Wilson, 151, *Bedford-street South.*
Nov.	1, 1869	Kinsman, W. N., *The Tower*, *Sandfield Park.*
Jan.	27, 1879	Kynaston, J. W., 149, *Kensington.*
Oct.	21, 1844	Lear, John, *Stoneby Cottage*, *Stoneby Green*, *New Brighton.*
Nov.	3, 1873	Lee, Hamilton (Messrs. Lee & Nightingale), *North John-street.*
*Dec.	11, 1871	Leigh, Richmond, M.R.C.S,, L.S.A., Physician to St. George's Hospital for Diseases of the Skin, 15, *St. James's-road*, HON. LIBRARIAN.
Nov.	13, 1882	Levy, Philip S., 24, *North John-street.*
Nov.	14, 1881	Lloyd, Richard J., B.A., *Lombard Chambers*, *Bixteth-street.*
Oct.	31, 1881	Lodge, Oliver J., D.Sc.. Professor of Physics, University College, 26, *Waverley-road*, *Sefton Park.*
Dec.	1, 1879	Long, Rev. R. E., *Cambridge House*, *Upper Parliament-street.*
Feb.	7, 1881	Lovell, John, 17, *Gambier-terrace*, and "*Mercury*" *Office*, *Wood-street.*
April	17, 1865	McCheane, Wm., M.R.C.S., 47, *Shaw-street.*
March	23, 1874	McCulloch, D. B., 23, *Queen-buildings*, *Dale-street.*

Oct.	17, 1881	McLintock, R., 8, *Balmoral-road.*
Oct.	30, 1882	McMaster, John Maxwell (Messrs. J. B. Wilson, Dean & McMaster), 22A, *Lord-street.*
Oct.	2, 1882	MacCunn, John, M.A., Professor of Philosophy and Political Economy, University College, *Ashton-street.*
Nov.	1, 1880	Maitland, H. D.
Jan.	23, 1882	Marcus, Heinrich, *Trafford Chambers*, 58, *South John-street.*
Nov.	14, 1870	Marples, Joseph, 23, *Leece-street*, and *Carlton-road, Tranmere.*
Nov.	17, 1873	Marples, Josiah, *Melvill Chambers, Lord-street*, and *Broomfield, Egremont.*
Feb.	19, 1877	Marples, William, 8, *Mathew-street*, and *Alfred-road, Birkenhead.*
Feb.	9, 1874	Marsden, Peter Crook, *Lymefield, Heaton, near Bolton.*
Jan.	21, 1883	Martin, Studley, 27, *Brown's-buildings*, and 177, *Bedford-street South.*
Feb.	20, 1871	Mason, Alfred H., F.C.S., Lond. and Berlin, 56, *Hanover-street.*
Dec.	11, 1882	Mather, George Alexander, 103, *Edge-lane.*
Oct.	20, 1879	McArthur, Charles, F18, *Exchange-buildings.*
Nov.	13, 1882	McKenzie, Rev. John Monroe, 5, *Canning-street.*
Dec.	12, 1881	Medcraft, R., *Plym Villa, Trafalgar-road, Egremont.*
Nov.	17, 1873	Mellor, James, Jun., *Weston, Blundellsands.*
Dec.	14, 1874	Mellor, John, *Stansty, Waterloo Park, Waterloo.*
Oct.	20, 1879	Mellor, Thomas, *Edgewater, Blundellsands.*
Oct.	31, 1859	Moore, Thomas John, Corr. Mem. Z.S.L., Curator, Free Public Museum, *William Brown-street*, VICE-PRESIDENT.
Nov.	15, 1869	Morgan, Alfred, 10, *St. George's-crescent*, and 3, *Aughton-road, Birkdale, Southport.*
Nov.	1, 1880	Morrow, John, 73, *Canning-street.*
March	6, 1882	Morton, Geo. Henry, 122, *London-road.*

Jan. 8, 1855	Morton, Geo. Highfield, F.G.S., 122, *London-road.*
April 16, 1849	Moss, Rev. John James, B.A., *East Lydford Hall, Somerton, Somerset.*
Oct. 29, 1850	Mott, Albert Julius, F.G.S., *Crickley Hill, Gloucester*, Ex-President.
April 3, 1854	Mott, Charles Grey, 4, *Cavendish-road, The Park, Birkenhead.*
Oct. 31, 1881	Mount, Ed., *Brown-hill, Lydiate, Ormskirk.*
Dec. 16, 1878	Murphy, Rev. P., *St. Anthony's, Scotland-road.*
*Oct. 21, 1867	Muspratt, E. K., *Seaforth Hall, Seaforth.*
Oct. 20, 1856	Nevins, John Birkbeck, M.D.Lond., M.R.C.S., Late Lecturer on Materia Medica, Royal Infirmary School of Medicine, 3, *Abercromby-square*, Ex-President.
Feb. 6, 1865	Newton, John, M.R.C.S., 20, *Marmaduke-street, Edge-hill.*
Feb. 18, 1878	Nicholson, Robert, 11, *Harrington-street.*
Nov. 2, 1868	Norrie, Rev. B. A. W., M.A. Cantab., *The College School, Huyton.*
*Oct. 15, 1855	North, Alfred, 1, *Hanover-terrace, Notting-hill, London, W.*
Dec. 18, 1866	Owen, Peter (Farnworth & Jardine), *Liverpool and London Chambers.*
Nov. 2, 1874	Palmer, John Linton, F.S.A., F.R.G.S., Fleet Surgeon, R.N., 24, *Rock Park, Rock Ferry.*
Nov. 28, 1881	Parkyn, Jas., *Beaconsfield, Rake-lane, Liscard, Birkenhead.*
Nov. 13, 1882	Paton, Rev. William, *Mossgill House, New Ferry.*
Jan. 9, 1871	Patterson, J., 16, *Devonshire-road, Prince's Park.*
Nov. 4, 1861	Philip, Thomas D., 49, *South Castle-street*, and *Holly-road, Fairfield.*
Dec. 28, 1846	Picton, Sir James Allanson, F.S.A., Chairman of the Library and Museum Committee, 11, *Dale-street*, and *Sandy Knowe, Wavertree*, Ex-President.

Nov. 1, 1875 Picton, William Henry, *Woodlea*, *Waterloo Park*, *Waterloo.*

Feb. 24, 1879 Plastow, William, 383, *Scotland-road.*

Nov. 15, 1880 Pollard, Frederick, M.D. Lond., 52, *Rodney-street.*

*Jan. 22, 1866 Raffles, William Winter, 23, *Linden Gardens*, *London*, *W.*, and *Glan-y-mor*, *Penmaenmawr.*

Nov. 12, 1860 Rathbone, Philip H., *Liverpool and London Chambers* (H), and *Greenbank Cottage*, *Wavertree.*

March 24, 1862 Rathbone, Richard Reynolds, 17, *Lancaster-buildings*, *Tithebarn-street*, and *Beechwood House*, *Grassendale.*

*Jan. 7, 1856 Rawlins, Charles Edward, 12, *Rumford-court*, *Rumford-place*, and *Rock Mount*, *Rainhill.*

Jan. 9, 1870 Rawlins, Gerald W., *Brook Cottage*, *Rainhill.*

Jan. 7, 1878 Read, Robert, 23, *Berkeley-street.*

Nov. 17, 1851 Redish, Joseph Carter, *Lyceum*, *Bold-street.*

Oct. 31, 1881 Rendall, G. H., M.A., Principal of University College, 70, *Bedford-street.*

Oct. 31, 1881 Rennie, J. W., 54, *Foxhill-street.*

Nov. 29, 1869 Roberts, Isaac, F.G.S., *Kennessee*, *Maghull.*

Dec. 4, 1876 Roberts, Richard (Messrs. Roberts & Son), 18, *Hackins-hey*, and *Mossley-hill.*

Nov. 26, 1877 Roberts, J. Geo., L.D.S., R.C.S.I., 27, *Hope-street.*

Feb. 4, 1867 Robinson, Joseph F., 1, *Apsley-buildings*, *Oldhall-street.*

Oct. 4, 1869 Rogers, J. Frederick, 7, *Victoria-street*, and 22, *Ullet-road*, *Prince's Park.*

Jan. 10, 1876 Rogerson, George Russell, F.R.A.S., F.R.G.S., F.R.S.L., *Cook-street*, and *Allerton.*

Oct. 21, 1878 Roose, Edward B., 26, *North John-street.*

Oct. 29, 1877 Rosenheim, Jos. C., *Sunny Bank*, *Prince's Park.*

April 18, 1854 Rowe, James, 14, *South Castle-street*, and *Leyfield Grange*, *West Derby.*

Jan. 22, 1872 Russell, Edward R., "*Daily Post*" *Office, Victoria-street,* and 6, *Abercromby-square,* Ex-President.

Feb. 18, 1878 Russell, W., *Compton Hotel, Church-street.*

April 7, 1862 Samuel, Harry S., 69, *Onslow Gardens, South Kensington, London.*

Nov. 30, 1874 Samuel, William H., 145, *Upper Parliament-street.*

Nov. 29, 1880 Sang, Walter, 8, *Brompton Avenue, Sefton Park.*

Oct. 18, 1880 Schack-Sommer, Dr. (Messrs. Crosfield, Barrow and Co.), 328, *Vauxhall-road.*

March 19, 1883 Selwyn, Rev. E. C., M.A., *The College, Shaw-street.*

March 19, 1866 Sephton, Rev. John, M.A., *Liverpool Institute.*

Dec. 2, 1878 Serjeant, Jno., 128, *London-road.*

Nov. 2, 1868 Sharp, Charles, *Liverpool Institute.*

Jan. 23, 1882 Sharpe, Granville H., F.C.S., *Liverpool College of Chemistry, Duke-street.*

Jan. 7, 1878 Shearer, George, M.D., 173, *Upper Parliament-street.*

Oct. 18, 1875 Simpson, James, 10, *Rumford-place.*

Nov. 4, 1878 Slater, William, 5, *Tithebarn-street.*

Oct. 31, 1881 Smith, A. T., Jun., 5, *Bentley-road.*

Dec. 10, 1866 Smith, Elisha (Henry Nash & Co.), 12, *Tower-buildings North.*

April 4, 1870 Smith, James, 9, *Lord-street,* and *Ribblesdale Villas,* 22, *Merton-road, Bootle.*

Feb. 23, 1863 Smith, J. Simm, 1, *Warham-road, Croydon.*

Feb. 24, 1862 Snape, Joseph, Lecturer on Dental Surgery Royal Infirmary School of Medicine, 13, *Scarisbrick-street, Southport.*

April 20, 1874 Snow, Rev. T., M.A., 12, *St. Paul's-square.*

Dec. 2, 1878 Southward, Rev. W. T., M.A., Fellow of St. Catherine's College, Cambridge, *White House, Huyton.*

Nov. 12, 1860 Spence, Charles, 4, *Oldhall-street.*

Feb.	10, 1862	Spence, James, 18, *Brown's-buildings, Exchange,* and 10, *Abercromby-square.*
Jan.	13, 1868	Stearn, C. H., *Selwood, Mayon-road, Forest-hill, London.*
Nov.	18, 1878	Steel, Richard, 18, *Hackins-hey.*
Feb.	19, 1883	Steeves, Gilbert M., 24, *Falkner-street.*
Nov.	13, 1876	Stephens, Thomas English, *Seafield, Victoria-road, New Brighton.*
Oct.	24, 1876	Stern, Rev. William, D.D., 3, *Hope-place.*
Nov.	1, 1875	Stevenson, John, *Prince Alfred-road, Wavertree.*
Jan.	9, 1865	Stewart, Robert E., L.D.S., R.C.S., 37, *Rodney-street.*
Nov.	28, 1881	Sumner, R. M., 50D, *Lord-street.*
Nov.	29, 1880	Sword, Patrick, *Sunny Side, Moor-lane, Crosby.*
Feb.	18, 1878	Symes, Charles, Ph.D., *Park Way House, Park Way, Upper Parliament-street.*
April	17, 1882	Tapscott, W. W., 39, *Oldhall-street,* and 41, *Parkfield-road, Aigburth.*
Jan.	23, 1882	Tate, George, Ph.D., F.G.S., F.C.S., Liverpool College of Chemistry, *Duke-street.*
Feb.	18, 1878	Taylor, Geo., 23, *Seel-street.*
*Feb.	19, 1865	Taylor, John Stopford, M.D.Aberd., F.R.G.S., *Rivelin, Richmond Park, Anfield-road.*
Nov.	29, 1875	Tetley, John H., *Sunnyside,* 21, *Rock Park, Rock Ferry.*
Feb.	19, 1877	Thacker, Reginald P., *Mandeville, Aigburth-road.*
Oct.	21, 1878	Thompson, J. W., B.A.Lond. and Victoria, 62, *Dale-street.*
Oct.	30, 1882	Thomson, W. J., *Exchange-buildings,* and *Ghyll-bank, St. Helens.*
Nov.	17, 1850	Tinling, Chas., *Victoria-street,* and 29, *Onslow-road, Elm Park.*
Nov.	27, 1882	Tobias, Henry A., 18, *Hackins-hey.*
Dec.	4, 1876	Torpy, Rev. Lorenzo, M.A., *Setubal.*
*Feb.	19, 1844	Turnbull, James Muter, M.D,, Edin., M.R,C.P., 86, *Rodney-street.*

Oct. 21, 1861	Unwin, William Andrew, 11, *Rumford-place.*
Oct. 20, 1879	Veevers, Samuel, *Huyton.*
Nov. 15, 1880	Vicars, John, 29, *Seel-street.*
Feb. 24, 1879	Walker, R. S., J.P., Resident Secretary, General Insurance Co., 5, *Brunswick-street.*
March 18, 1861	Walker, Thomas Shadford, M.R.C.S., 88, *Rodney-street.*
Jan. 27, 1862	Walmsley, Gilbert G., 50, *Lord-street.*
Jan. 9, 1865	Walthew, William, *Phœnix Chambers*, and *Vine Cottage*, *Aughton.*
Feb. 19, 1877	Wallace, John, M.D., *Gambier-terrace.*
March 4, 1872	Ward, Thomas, *Brooklands House*, *Northwich.*
Dec. 2, 1861	Weightman, William Henry, *Minster-buildings*, *Church-street*, and *Cambridge-road*, *Seaforth.*
Oct. 30, 1876	Weightman, Arthur (Messrs. Field & Weightman), *Talbot Chambers*, 3, *Fenwick-street*, *W.*
Nov. 13, 1882	Wightman, William, 17, *Park Way.*
Dec. 13, 1880	Whitford, William, M.D., 37, *Shaw-street.*
Nov. 27, 1882	Whitmell, Charles T., 8, *Maryland-street.*
April 7, 1862	Whittle, Ewing, M.D., Lecturer on Medical Jurisprudence, Royal Infirmary School of Medicine, 77A, *Upper Parliament-street.*
Nov. 14, 1881	Williams, Rev. S. Fletcher, 85, *Everton-road.*
Oct. 31, 1881	Williams, Richard, M.D., 82, *Rodney-street.*
Nov. 2, 1874	Wolf, Jas. O. de (Messrs. T. C. Jones & Co.), 26, *Chapel-street.*
Nov. 14, 1870	Wood, John J. (Messrs. Abraham & Co.), 20, *Lord-street.*
Nov. 29, 1875	Yates, D. E., 26, *Castle-street*, and 38, *Huskisson-street.*
Nov. 13, 1876	Yates, Edward Wilson, 37, *Castle-street.*
Nov. 2, 1874	Young, Henry, *South Castle-street.*
Oct. 30, 1882	Zicaliotti, Alexander, 60, *Cable-street*, and 7, *Grove Park.*

HONORARY MEMBERS.

LIMITED TO FIFTY.

1.—1836 The Most Noble William, Duke of Devonshire, K.G., M.A., F.R.S., D.C.L., F.G.S., etc., Chancellor of the University of Cambridge, *Chatsworth, Derbyshire*, and 78, *Piccadilly, London, W.*

2.—1838 Sir George Biddell Airy, K.C.B., M.A., LL.D., D.C.L., F.R.S., F.R.A.S., etc., *Royal Observatory, Greenwich.*

3.—1840 James Nasymth, F.R.S., *Penshurst, Kent.*

4.—1844 T. B. Hall, *Crane House, Yarmouth.*

5.—1844 Peter Rylands, M.P., *Warrington.*

6.—1844 William B. Carpenter, M.D., F.R.S., F.L.S., Corresponding Member of the Institute of France, etc., *London.*

7.—1850 The Rev. Canon St. Vincent Beechy, M.A., Rector of Hilgay, *Norfolk.*

8.—1851 The Rev. Robert Bickersteth Mayor, B.D., Rector of Frating, Essex.

9.—1857 Thomas Joseph B. Hutchinson, F.R.G.S., F.R.S.L., F.E.S., *Ballinescar Lodge, Curracloe, co. Wexford.*

10.—1861 The Rev. Thomas P. Kirkman, M.A., F.R.S., Rector of Croft, *near Warrington.*

11.—1865 The Right Rev. T. N. Staley, D.D., late Bishop of Honolulu, Vicar of Croxhall, *Staffordshire.*

12.—1865 Sir Edward J. Reed, K.C.B., F.R.S., M.P., *Hextable, Dartford, Kent.*

13.—1865 Cuthbert Collingwood, M.A., M.B., F.L.S., 4, *Grove-terrace, Belvedere-road, Upper Norwood, London, S.E.*

14.—1867 J. W. Dawson, LL.D., F.R.S., etc., Principal and Vice-Chancellor of McGill University, *Montreal.*

15.—1868 Captain Sir James Anderson, 16, *Warrington-crescent, Maida Hill, London, W.*

16.—1870 Sir John Lubbock, Bart., M.P., F.R.S., etc., *High Elms, Farnborough, Kent.*

17.—1870 Professor Henry E. Roscoe, F.R.S., etc., *Owens College, Manchester.*

18.—1870 Sir Joseph Dalton Hooker, M.D., F.R.S., etc., *Kew.*

19.—1870 Professor Brown Sequard, M.D.

20.—1870 John Gwyn Jeffreys, F.R.S., *Ware Priory, Herts.*

21.—1870 Professor Thomas H. Huxley, LL.D., F.R.S., etc., 4, *Marlborough-place, London, N.W.*

22.—1870 Professor John Tyndall, LL.D., F.R.S., etc., *Royal Institution, London.*

23.—1870 The Rev. Christian D. Ginsburg, LL.D., *Binfield, Bracknell, Berks.*

24.—1874 Professor Alexander Agassiz, Director of the Museum of Comparative Zoology, *Harvard, Cambridge, Massachusetts.*

25.—1874 Professor Frederick H. Max Müller, LL.D., *Oxford.*

26.—1874 Sir Samuel White Baker, Pasha, F.R.S., F.R.G.S., etc., *Sandford Orleigh, Newton Abbot, Devonshire.*

27.—1877 Professor F. V. Hayden, M.D., etc., Director of the United States Geological and Geographical Survey of the Territories, *Washington.*

28.—1836 Alfred Higginson, M.R.C.S., 185, *Tulse Hill, London,* also an Ordinary Life Member.

29.—1877 The Earl of Crawford and Balcarres, F.R.S., Foreign Secretary of R.A.S., etc., 9, *Grosvenor-square, London.*

30.—1877 Albert C. N. Günther, M.A., M.D., Ph.D., British Museum.

31.—1877 Adolphus Ernst, M.D., Principal of the Department of Science, Philosophy, and Medicine, University of Caracas.

32.—1877 Dr. Leidy, Academy of Science, *Philadelphia.*

33.—1877 Dr. Franz Steindachner, Royal and Imperial Museum, *Vienna.*

34.—1877 The Rev. H. B. Tristram, M.A., LL.D., F.R.S., Canon of Durham, *The College, Durham.*

35.—1880 Joseph Mayer, F.S.A., *Pennant House, Bebington.*

36.—1881 H. J. Carter, F.R.S., *The Cottage, Budleigh Salterton, Devon.*

37.—1881 The Rev. Thomas Hincks, B.A., F.R.S., *Stokeleigh, Leigh Woods, Clifton, Bristol.*

38.—1881 The Rev. W. H. Dallinger, F.R.S., *Wesley College, Sheffield.*

CORRESPONDING MEMBERS.

LIMITED TO THIRTY-FIVE.

1.—1867 J. Yate Johnson, *London.*

2.—1867 R. B. N. Walker, F.R.G.S., F.G.S., *West Africa.*

3.—1868 Rev. J. Holding, M.A., F.R.G.S., *London.*

4.—1868 George Hawkins, *Colombo, Ceylon.*

5.—1868 J. Lewis Ingram, *Bathurst, River Gambia.*

6.—1869 George Mackenzie, *Cebu, Philippine Islands.*

7.—1870 Rev. Joshua Hughes-Games, D.C.L., King William's College, *Isle of Man.*

8.—1874 Samuel Archer, Surgeon-Major, *Singapore.*

9.—1874 Coote M. Chambers, *Burrard's Inlet, British Columbia.*

10.—1874 Edwyn C. Reed, *Santiago de Chili.*

11.—1874 Millen Coughtrey, M.D., *Dunedin, Otago, New Zealand.*

12.—1875 Robert Gordon, Government Engineer, *British Burmah.*

13.—1877 Edward Dunkinfield Jones, C.E., *Sao Paulo, Brazil.*

14.—1877 Miss Horatio K. F. Gatty, *Ecclesfield Vicarage, Wakefield,*

15.—1877 Dr. Allen, *Jamaica.*

16.—1877 Dr. George Bennett, *Sydney.*

17.—1877 Dr. David Walker, *Benicia, U.S.A.*

ASSOCIATES.

LIMITED TO TWENTY-FIVE.

1.—Jan. 27, 1862 Captain John H. Mortimer, "America." (Atlantic.)

2.—Mar. 24, 1862 Captain P. C. Petrie, "City of London," Commodore of the Inman Line of American Steam Packets. (Atlantic.)

3.—Feb. 9, 1863 Captain James P. Anderson, Cunard Service. (Atlantic.)

4.—Feb. 9, 1863 Captain John Carr (Bushby & Edwards), ship "Scindia." (Calcutta.)

5.—Feb. 9, 1863 Captain Charles E. Price, R.N.R. (L. Young & Co.), ship "Cornwallis." (Calcutta and Sydney.)

6.—April 20, 1863 Captain Fred. E. Baker, ship "Niphon." (Chinese Seas.)

7.—Oct. 31, 1864 Captain Thomson, ship "Admiral Lyons." (Bombay.)

8.—April 13, 1865 Captain Alexander Cameron (Boult, English & Brandon), ship "Staffordshire." (Shanghai.)

9.—Dec. 11, 1865 Captain Walker, ship "Trenton."

10.—Mar. 23, 1868 Captain David Scott.

11.—Oct. 5, 1868 Captain W. H. Cawne Warren, ship "Bedfordshire."

12.—Mar.	22, 1869	Captain Robert Morgan, ship "Robin Hood."
13.—April	29, 1872	Captain J. B. Walker, Old Calabar.
14.—April	29, 1872	Captain Alfred Horsfall, S.S. "Canopus."
15.—Oct.	18, 1875	Captain John Slack.
16.—Feb.	19, 1877	Arthur B. Nevins, Melbourne.
17.—Dec.	2, 1878	Captain C. A. Sibthorpe, S.S. "European."
18.—Dec.	2, 1878	Captain A. T. Cooper, P. S. N. Co.'s S.S. "Illimani."
19.—April	17, 1882	Captain Lecky, R.N.R., F.R.A.S.

VOLUMES PRESENTED TO THE SOCIETY DURING THE SEVENTY-SECOND SESSION, 1882–1883.

A.

Astronomical Society, Royal. Memoirs of the, vol. xlvi. London, 1881. Journal, vol. xlii, 1881–82.

Association, British. Report of the York Meeting, 1881. Ditto Southampton Meeting, 1882.

Arts and Sciences, Connecticut Academy of. Transactions, vol. iv., parts 1 and 2. New Haven, 1882.

Archæological Society, The Somersetshire. Proceedings, vol. vii. Taunton, 1882.

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Archæology, U.S. Geographical Survey, vol. vii.

Akademie, Sitzungsberichte der Kaiserliche. Phil. Hist. Classe. Band xcviii and xcix. Vienna, 1881.

Association, American. Proceedings, vol. xxix. Boston, 1880. Vol. xxx. Salem, 1882.

Arts and Sciences, American Academy of. Memoirs, vol. xi., part. Proceedings, vols. viii and ix. Boston, 1881.

Asiatic Society of Bengal. Proceedings, 1, 2, 3, 4. Calcutta, 1881.

Academy Royal, of Copenhagen. Oversigt, Nos. 1, 2. 1881.

Academy, Royal Irish. Transactions. Science, vol. xxviii. and vol. iii., ser. ii.

Antiquities and Polite Literature. Proceedings of ditto, vol. ii.

Arts, Society of, London. Journal, 1882.

Asiatic Society, Royal, London. Journal, vol. xiv.

Architects, Royal Institute of British, London. Transactions, 1881-1882. List of Members of ditto, 1882--83.

Archæology and Ethnology. Peabody Museum of American, Cambridge, Mass. Report, 1882.

Asiatic Society of Bombay. Journal, vol. xiv.

Anthropological Institute, Journal of, London, 1881–82.

Abbeville, Bulletin des Proces-Verbales de la Societé d'Emulation, 1877–80.

B.

Birds, Catalogue of, British Museum, part vi.

Biographie des Membres de l'Académie Royale. Band ii., haften i. Stockholm, 1881.

C.

Canada, Geological and Natural History Survey of. Montreal, 1881.

Congressional Directory. Washington, 1882.

Cornwall, Royal Institution of. Journal, vol. vii. Truro, 1882.

Columbia River, Upper. Report of an Examination of the, by Lieut. T. W. Symons. Washington, 1882.

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Chemical Society, London, Journal of, 1882.

D.

Damuda, Flora of, in Palæontologica Indica, part 3. Calcutta, 1881.

E.

Engineers, Institution of Civil. Proceedings, vols. lxvii–lxix. London, 1882.

Engineers, Report of the Chief of, U.S. Army. Washington, 1881.

Essex Institute. Bulletin, vol. xiii. Salem, Mass.

Ethnology, Bureau of, Washington. First Annual Report, 1881.

Electricity and Gas, Reports of the Exhibition of Uses. Glasgow.

F.

Franklin Institute, Journal. Philadelphia, 1882.

Fingal's Cave, "Is it Artificial?" by F. C. Whitehouse. New York, 1882.

G.

Geological Association, Liverpool. Transactions, 1880–81.

Geological and Natural History Survey of Canada. Report and Maps. Montreal, 1881.

Geographical Society, American, Bulletin of the, New York, 1881. Journal of, vol. xiii. New York, 1882.

Geological Society of Cornwall, Royal. Vol. x., parts 1–4. Penzance, 1882.

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Gondwana, Fossil Flora of, in Palæontologica Indica, ser. ii., Nos. xi, xii. Calcutta, 1881.

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H.

Health, Medical Officer of, Liverpool. Report, 1881.

Health, Massachusetts Department of. Report. Boston, 1882.

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I.

India, Geological Survey of. Memoirs, vol. xix. Records, vol. xv.

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L.

Libraries, Free Public, Manchester. Reports, 1881–82.
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Library, Astor, New York. Report, 1881–83.
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M.

Météorologiques, Observations, from La Société des Sciences de Finlande, Helsingfors, 1878–80.
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Meteorological Society of Scotland. Journal, Nos. lxiv. to lxix.
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Minerals of New South Wales in 1881, by Arch. Liversidge, F.R.S. Sydney, 1882.
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N.

Naturalists' Field Club, Liverpool. Report, 1881–82.
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Natural History Society and Field Club, Hertfordshire. Transactions, vol. i.

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Naturalists' Field Club, Belfast. Report and Proceedings, 1879–81.

Natural History and Philosophical Society, Belfast. Proceedings, 1882.

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Natural History Society, Boston. Memoirs and Proceedings, 1882.

O.

Ordnance, Report of the Chief of, U.S.A. Washington, 1881.

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P.

Philomathic Society, Liverpool. Proceedings, 1881–82.

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S.

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V.

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W.

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Z.

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SOCIETIES, ACADEMIES, AND OTHER INSTITUTIONS,

TO WHICH THIS VOLUME IS PRESENTED.

(Donations received this Session from those prefixed with an Asterisk.)

Great Britain and Ireland.

Aberdeen	The Dun-Echt Observatory.
Alnwick	*The Berwickshire Naturalists' Field Club.
Bath	The Natural History and Antiquarian Field Club.
Belfast	The Naturalists' Field Club.
Belfast	The Natural History and Philosophical Society.
Birkenhead	The Free Public Library.
Birkenhead	*The Literary and Scientific Society.
Birmingham	*The Philos. Society.
Bristol	*The Naturalists' Society.
Chester	*The Society of Natural Science.
Cambridge	*The Union Society.
Dublin	The Royal Irish Academy.
Dublin	*The Royal Geological Society of Ireland.
Dublin	The Royal Society.
Edinburgh	*The Botanical Society.
Edinburgh	*The Geological Society.
Edinburgh	The Meteorological Society of Scotland.
Edinburgh	*The Philosophical Institution.
Edinburgh	The Royal Observatory.
Edinburgh	The Royal Physical Society.
Edinburgh	The Royal Scottish Society.

Edinburgh - - - - *The Royal Society of Arts.
Falmouth - - - - *The Royal Cornwall Polytechnic Society.
Glasgow - - - - - *The Philosophical Society.
Glasgow - - - - - The Geological Society.
Greenwich - - - - The Royal Observatory.
Halifax - - - - - *The Literary and Philosophical Society.
Hull - - - - - - *The Literary and Philosophical Society.
London - - - - - *The Anthropological Institute.
London - - - - - *The Society of Antiquaries.
London - - - - - *The Royal Institute of British Architects.
London - - - - - *The Society of Arts.
London - - - - - *The Royal Asiatic Society.
London - - - - - *The Royal Astronomical Society.
London - - - - - The British Association.
London - - - - - *The British Museum.
London - - - - - *The Chemical Society.
London - - - - - *The Royal Geographical Society.
London - - - - - *The Geological Society.
London - - - - - *The Geologists' Association.
London - - - - - *The Institution of Civil Engineers.
London - - - - - *The East Indian Association.
London - - - - - *The Linnæan Society.
London - - - - - *The Meteorological Society.
London - - - - - *The Royal Microscopical Society.
London - - - - - *The Royal Medico-Chirurgical Society.
London - - - - - *The Royal Society.
London - - - - - *The Royal Institution.
London - - - - - *The Royal Society of Literature.
London - - - - - *The Statistical Society.
London - - - - - *The Zoological Society.
London - - - - - *The Editor of "Nature."
London - - - - - *The Editor of "The Journal of Science."
London - - - - - *The Editor of "Science Gossip."
London - - - - - *The Editor of "The Scientific Roll."
London - - - - - *The Philosophical and Literary Society.
Leeds - - - - - - *The Philosophical and Literary Society.

Leeds	*The Yorkshire Geological and Polytechnic Society.
Leicester	*The Literary and Philosophical Society.
Liverpool	The Architectural and Archæological Society.
Liverpool	The Chemists' Association.
Liverpool	*The Engineering Society.
Liverpool	*The Geological Society.
Liverpool	The Geological Association.
Liverpool	The Historic Society of Lancashire and Cheshire.
Liverpool	The Microscopical Society.
Liverpool	*The Naturalists' Field Club.
Liverpool	*The Philomathic Society.
Liverpool	*The Polytechnic Society.
Liverpool	The Athenæum Library and News Room.
Liverpool	*The Free Public Library.
Liverpool	The Liverpool Library.
Liverpool	The Lyceum News Room.
Liverpool	The Medical Institution.
Liverpool	The Royal Institution.
Liverpool	University College.
Manchester	*The Literary Club.
Manchester	*The Literary and Philosophical Society.
Manchester	Chetham Library.
Manchester	*The Free Public Library.
Manchester	Owens College.
Manchester	The Editor of "The Field Naturalist and Scientific Student."
Newcastle-on-Tyne	*The Natural History Society of Northumberland and Durham.
Oxford	The Ashmolean Society.
Oxford	The Union Society.
Penzance	*The Royal Geological Society of Cornwall.
Plymouth	*The Plymouth Institution.
Taunton	*The Somersetshire Archæological Society.
Truro	*The Royal Institution of Cornwall.

Watford	*The Hertfordshire Natural History Society and Field Club.
Welshpool	*The Powys-Land Club.
Whitby	*The Literary and Philosophical Society.
Woodford	*The Epping Forest Naturalists' Field Club.

BRITISH COLONIES AND THE UNITED STATES.

Bombay	*The Royal Asiatic Society.
Boston	*The American Academy of Arts and Sciences.
Boston	The Massachusetts Board of Agriculture.
Boston	The Massachusetts Board of Education.
Boston	*The Massachusetts Board of Health, Lunacy, and Charity.
Boston	*The Natural History Society.
Boston	The Public Library.
Buffalo	*The Society of Natural Sciences.
Burlington	The Orleans County Society of Natural History.
Calcutta	*The Asiatic Society of Bengal.
Calcutta	*The Geological Survey of India.
Cambridge (Mass.)	*Harvard University.
Cambridge (Mass.)	*Museum of Comparative Zoology.
Cambridge (Mass.)	*The Peabody Museum of American Archæology and Ethnology.
Chicago	The Public Library.
Davenport	The Academy of Natural Sciences.
Melbourne	The Royal Society of Victoria.
New Haven	The Connecticut Academy of Arts and Sciences.
New York	*The Academy of Sciences.
New York	*The Astor Library.
New York	*The American Geographical Society.
New York	The City University.
New York	The State University.

New York - - - The State Library.
New York - - - The American Museum of Natural History.
Otago - - - - The University.
Ottawa - - - - Geological and Natural History Survey.
Ottawa - - - - The Library of Parliament.
Philadelphia - - The Academy of Natural Sciences.
Philadelphia - - *The American Philosophical Society.
Philadelphia - - *The Franklin Institute.
Philadelphia - - The Pennsylvania Board of Public Education.
Philadelphia - - *The Zoological Society.
Salem - - - - - The American Association for the Advancement of Science.
Salem - - - - - *The Essex Institute.
San Francisco - - The Lick Observatory.
Sydney - - - - *The Royal Society of New South Wales.
Toronto - - - - *The Canadian Institute.
Washington - - - *The Department of Agriculture.
Washington - - - *The Geological and Geographical Survey of the Territories.
Washington - - - *The Naval Observatory.
Washington - - - *The Smithsonian Institution.
Washington - - - *The War Office:—*The Ordnance Department; the Office of the Chief Signal Officer; * the Department of the Chief of Engineers; the Department of the Paymaster-General; the Department of the Surgeon-General.
Wellington - - - *The New Zealand Institute.

FOREIGN.

Bordeaux - - - La Société des Sciences Physiques et Naturelles.
Brussels - - - - *L'Académie Royale des Sciences, des Lettres, et des Beaux-Arts de Belgique.

Cherbourg	*La Société Nationale des Sciences Naturelles.
Christiana	The University.
Copenhagen	*L'Académie Royale.
Copenhagen	La Société Royale des Antiquaries du Nord.
Geneva	La Société de Physique et d'Histoire Naturelle.
Gottingen	*Der Königlichen Gesellschaft der Wissenschaften.
Grieswald	The University.
Harlem	*La Société Hollandaise des Sciences.
Helingsfors	*La Société des Sciences de Finlande.
Königsberg	Der Königlichen Physikalisch-ökonomischen Gesellschaft.
Milan	*La Reale Instituto Lombardo.
Munich	*Der Königlichen Akademie der Wissenschaften.
Paris	*L'Ecole Polytechnique.
Presburg	*Vereins fur Natur und Heil-kunde.
St. Petresburg	*L'Académie Imperiale des Sciences.
Stockholm	*L'Académie Royal Suedoise des Sciences.
Strasburg	La Bibliothèque Municipale.
Strasburg	*Der Kaiserliche Universitäts und Landes-Bibliothek.
Tokio	*The University.
Toulouse	L'Observatoire Astronomique.
Vienna	*Der Kaiserliche Akademie der Wissenschaften.
Vienna	*Der Geographischen Gesellschaft.

TREASURER'S ACCOUNT, 1881-82.

Dr. *The* Literary and Philosophical Society, *in Account with* R. C. Johnson, *Treasurer.* **Cr.**

1881-82.	£	s.	d.
To Cash paid D. Marples & Co. Limited (Printing)	117	7	0
„ „ Tinling & Co. (Circulars)	9	8	0
„ „ Secretary's Expenses	17	5	0
„ „ „ Editorial Fee	10	10	0
„ „ Doling (Refreshments)	30	9	0
„ „ Burke (Attendance)	1	15	0
„ „ Rent	20	0	0
„ „ Librarian's Expenses	6	13	10
„ „ Treasurer's Expenses	1	6	4
„ „ Knott for Lantern for Mr. Morton's paper	1	3	0
„ Balance from last account	10	3	1
„ Dock Bond in hand	150	0	0
„ Balance of Cash in hand	18	18	8
	£394	18	11

1881-82.				£	s.	d
By Balance from last account:—						
Dock Bond				150	0	0
Subscribers 27 Entrance Fees, at 10s. 6d.	14	3	6			
„ 193½ Annual	203	3	6			
„ 20 Arrears	21	0	0			
				238	7	0
Interest on Dock Bond				6	11	11
				£394	18	11

Examined and found correct,

(Signed), ISAAC ROBERTS.
RICHARD STEEL.

PROCEEDINGS

OF THE

LIVERPOOL LITERARY AND PHILOSOPHICAL SOCIETY.

ANNUAL MEETING.—SEVENTY-SECOND SESSION.

ROYAL INSTITUTION, 2nd October, 1882.

EDWARD DAVIES, F.C.S., F.I.C., PRESIDENT, in the Chair.

THE Minutes of the last Meeting of the previous Session were read and confirmed.

The Honorary Secretary read the following

REPORT.

The Council of the Literary and Philosophical Society, at the close of another year, have to report that the Society's affairs are in a satisfactory condition; the number of Ordinary Members has considerably increased, and the Honorary Treasurer is able to present a favourable Balance-sheet.

The proceedings of the past Session were, throughout, of an interesting character, and attracted good attendances at each meeting.

The Volume containing the record of these Proceedings will probably be ready for distribution at the end of October, its publication being delayed for the completion of a very valuable paper on the Lepidoptera of Brazil, contributing facts and information new to Natural Science, by our esteemed Corresponding Member, Mr. Dukinfield Jones.

During the Session, the Society lost nine Ordinary Members—seven by resignation and two by death. Its numerical strength was, however, augmented by the election of thirty members. The roll has thus been extended from 237 at the beginning of the Session to 258 at its close.

The two Members deceased are Mr. GEORGE S. WOOD, who had been connected with the Society for twenty-one years, and had contributed to its Proceedings, and the Rev. Professor JACOB PRAG, whose reputation as a Hebrew scholar merits a record in this Report.

Professor Prag was born at Dantzig, in the year 1816. He studied at the Rabbinical school at Lebau, and after fulfilling various educational and ministerial posts in Prussia, was appointed minister of the Old Hebrew Congregation in Liverpool. With this office he combined the Head Mastership of the Jewish schools, and after eleven years was elected Professor of Hebrew in Queen's College, where he numbered among his pupils some who have since adorned Christian pulpits. Professor Prag's knowledge of Talmudic literature was profound, and his acquaintance with Semitic languages extensive; and he was regarded as an authority on these subjects, not only in this Society, of which he had been a valued member for fifteen years, but throughout the kingdom also—questions on Talmudic subjects being frequently submitted to him for elucidation, from the Universities as well as from other inquirers. During the controversy which arose on the alleged discovery of a stone with Phœnician inscriptions, at Parahyba, in Brazil, in 1874, he published a translation of the writing in the *Academy* of that year, and took part in the discussion; and this Society was indebted to him for one of the earliest translations of the inscription on the Moabite Stone. Professor Prag was further well known as an accomplished "sofer" or "scribe," and his beautifully written Scrolls of the Law are used in numerous Synagogues. He was an enthusiastic book collector, and his extensive library contained some manuscripts of great antiquity. He died at London, in December, 1881.

Among the Honorary Members the Society has lost Sir CHARLES WYVILLE THOMPSON, F.R.S., Professor of Natural History in Edinburgh University.

The election of three gentlemen in the last Session, namely, H. J. CARTER, F.R.S., the Rev. THOMAS HINCKS, F.R.S., and the Rev. Professor DALLINGER, F.R.S., who have rendered valuable services to the Society, raises the number of these Members to 39. The list of Corresponding Members (17) remains unaltered, and one additional Associate has been elected. The Society, accordingly, now consists of 258 Ordinary Members, 39 Honorary Members, 17 Corresponding Members, and 19 Associates.

The Report was adopted on a motion from the Chair, seconded by the Rev. Dr. STERN. The Treasurer's Annual Statement was also approved of and passed.

The following Office-bearers and Members of Council were then duly elected:—

Vice-Presidents.—Thos. J. Moore, Cor. Mem. Z.S.L., Thomas Higgin, F.L.S., Professor J. Campbell Brown, D.Sc., &c. Honorary Treasurer.—Richard C. Johnson, F.R.A.S. Honorary Secretary.—James Birchall. Honorary Librarian.—Richmond Leigh, M.R.C.S.E. Members of Council.— W. Carter, M.D., Richard Steel, Isaac Roberts, F.G.S., F.R.A.S., J. Sibley Hicks, L.R.C.P., Josiah Marples, Malcolm Guthrie, J.P., John W. Hayward, M.D., Alfred Morgan, Baron L. Benas, Robert Nicholson, Principal Rendall, M.A., Henry Longuet Higgins, Rev. W. Stern, D.D., Professor Oliver J. Lodge, D.Sc.

The Associates of the Society were re-elected.

Professor John MacCunn, M.A., was unanimously elected an Ordinary Member.

A vote of thanks to the donors of books and transactions presented during the past Session was unanimously passed, on the motion of Dr. Nevins, seconded by Mr. Isaac Roberts, F.G.S., F.R.A.S.

It was next moved by Mr. Roberts, seconded by Mr. R. C. Johnson, F.R.A.S., and carried unanimously, "That a set of the Society's Proceedings be presented to University College, and that the College be placed on the list of institutions receiving presentation copies of the Society's publications."

The President then delivered an Address on "The Unity of Life." *

FIRST ORDINARY MEETING.

Royal Institution, 16th October, 1882.

EDWARD DAVIES, F.C.S., F.I.C., President, in the Chair.

Professor Herdman, D.Sc., was unanimously elected an Ordinary Member.

Mr. Josiah Marples exhibited some dried flowers used in Athens as wicks for night lights.

The Rev. H. H. Higgins read a short paper on an "Ammonite from the Inferior Oolite, near Turvey, Bedfordshire."†

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* See page 1. † See page 135.

Professor **Herdman** communicated some "Notes on the Marine Zoology of the Coast of Mull," which formed the introductory portion of a paper, to be hereafter completed, upon work done during the summer of 1881 and 1882, on the Invertebrate Fauna of the seas around the island of Mull. The methods of investigation were dredging and tow-netting in the Sound of Mull and off the west coast between Mull and Coll, and shore collecting at various points along the east, north, and west coasts of Mull and upon Inchkenneth. The Fauna, as a whole, was found to be a very rich one, and very similar to that of the Clyde district. Then followed some remarks upon the more rare, interesting, or characteristic animals, which are better deferred until the publication of the complete lists.

Mr. **Frank Archer** exhibited specimens, preserved in spirit, of *Funiculina quadrangularis*, an elongated Coralline, several feet in length, dredged by himself and Mr. Darbyshire, near Oban, which were intended for presentation to the Free Public Museum.

Mr. F. P. **Marrat** next contributed some information on "Links between Examples of Specific Forms in the Shells of the Genus Oliva," and exhibited a case of specimens from the Free Public Museum to illustrate his remarks.

Mr. T. J. **Moore** exhibited some nests of the *Antennarius* or *Chironectes*, the diminutive Frog Fish or Marbled Angler, recently presented, with various other specimens, to the Free Public Museum by Capt. S. Griffith Jones, of the barque "Hermine."

In an accompanying note Capt. Jones states that "on the 18th of April, 1882, latitude 22° 30′ N., longitude 41° 40′ W., we collected from the Gulf weed, and passed a great number of nests of the Marbled Angler. I think that they belonged to these fish because each contained one or more of them. The size of the nest was as large as a cocoanut, and quite round. Some had no entrance left; others had a tortuous passage through. Small crabs were busily devouring the ova. The nests held together by an interlacing of thread-like filaments, which at first I took to be ravellings of sail canvas, but on examination I found that it was composed of a great many very minute silky fibres, or filaments, like spider web. The eggs seemed fastened to these threads by the same kind of fibre. Some of the eggs were empty, others still contained the embryo, the pulsations of which were discernible with the first joint of a telescope, the only magnifying power at hand."

Mr. Moore stated that the late Professor Louis Agassiz had described with great enthusiasm his first capture of the Frog Fish and its nest at the commencement of his voyage in the "Haslar"; and that Capt. Mortimer, Associate of the Society, had once brought a living specimen to the Museum.

Mr. Moore also exhibited a specimen, recently added to the Museum, of *Dorcopsis luctuosa,* a species of Kangaroo, from the S.E. of New Guinea, discovered and described by Signor L. M. d'Albertis, the distinguished Italian Naturalist and Explorer. (See *Proceedings of the Zoological Society of London,* 1874, p. 110.)

Mr. Richardson, the Curator, exhibited some rare plants from the Botanic Gardens, including the Prickly Comfrey from the Caucasus, the Kola Nut Tree from tropical Africa, the Pitcher Plant from New Holland, and Side Saddle Flowers from South Carolina.

SECOND ORDINARY MEETING.

Royal Institution, 30th October, 1882.

EDWARD DAVIES, F.C.S., F.I.C., President, in the Chair.

Messrs. Henry N. Hindley, John B. Clarke, Alexander Zicaliotti, W. J. Thomson, R. S. Brook, and John Maxwell MacMaster were duly elected Ordinary Members.

A paper was read by Mr. JOSIAH MARPLES on "The Last Dauphin of France." *

THIRD ORDINARY MEETING.

ROYAL INSTITUTION, 13th November, 1882.

EDWARD DAVIES, F.C.S., F.I.C., PRESIDENT, in the Chair.

Messrs. Frederick Rose, L.D.S. Eng., Philip S. Levy, Willoughby Gardner, William Wightman, John Monroe McKenzie, and the Rev. William Paton were duly elected Ordinary Members.

Mr. R. C. JOHNSON, F.R.A.S., read some "Notes on the Comet," illustrated with diagrams.

Mr. BIRCHALL read a short note on "The German Empire of the Middle Ages."

Mr. R. McLINTOCK read a paper on "The Nibelungenlied."†

Previous to this Ordinary Meeting an EXTRAORDINARY MEETING was held, the PRESIDENT in the Chair.

The Meeting was held on the recommendation of the Council, which reported that the crowded state of the Library and the difficulty of finding further accommodation in the Royal Institution, rendered it necessary to take into consideration further means of provision.

The following resolutions were proposed by the HON. SECRETARY, and seconded by the HON. LIBRARIAN, on behalf of the Council:—

1. "That all Publications and Proceedings of Societies, except such sets as are retained by the Council, be

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* See page 25. † See page 109.

presented to University College at the end of each Session."

2. "That the Council be empowered to deal with the Books now in the Library on the principle of the foregoing resolution."

A long discussion followed, which was terminated by the carrying of the following amendment, moved by Dr. **Nevins**, seconded by Mr. A. H. **Mason** :—

"That the resolutions be referred back to the Council for re-consideration, with a request that they may be brought before the Society at some future Meeting."

FOURTH ORDINARY MEETING.

Royal Institution, 27th November, 1882.

EDWARD DAVIES, F.C.S., F.I.C., President, in the Chair.

Messrs. Charles T. Whitmell and Henry A. Tobias were duly elected Ordinary Members.

Mr. **Hunter** exhibited some samples of young potatoes which he had grown inside older ones, and from which they had derived their sole nourishment.

The Rev. **Thos. P. Kirkman**, M.A., F.R.S., presented a communication "On Polyedra whose Summits are all Triedral, and which have neither Triangle nor Quadrilateral."*

Dr. **Nevins** read the following extracts from letters and newspapers from the Cape of Good Hope, showing that the Comet's appearance had first been reported in that locality, where it was known, in honour of its discoverer, as "Finlay's

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* See page 49.

Comet." Mr. Finlay, therein mentioned, was a son of the late Mr. Finlay, Mathematical Master in the Liverpool College, and formerly a member of this Society.

FINLAY'S COMET—DISCOVERY.

By J. B. NEVINS, M.D., M.R.C.S.

This brilliant comet was discovered on the 7th September, 1882, by Mr. William Henry Finlay, F.R.A.S., Chief Assistant at the Royal Observatory, Cape Town, a son of the late Mr. William Finlay, who was one of our oldest members, and was so well known in the neighbourhood for his mathematical attainments, and his position as Mathematical Master in the Liverpool College, and tutor to two Senior Wranglers, Mr. Pendlebury and Professor Forsyth, both of whom were Liverpool boys, and received their early training under his instruction.

The following account of the discovery is taken from a lecture delivered before the South African Philosophical Society, by Dr. Gill, the Astronomer Royal at the Cape Town Observatory.

The comet was first discovered on the morning of the 7th September, when it was shining with the brilliancy of a star of the third or fourth magnitude, and showed a not very brilliant tail of about two degrees in length. It was of a very bright white colour. Mr. Finlay had been observing the occultation of a star, and, while returning into the Observatory, his eye was directed to the unusual object, which he recognised to be a comet, and he at once made the necessary observations, which consisted in determining the difference of time in which any small star near the comet passed the lines marked on the telescope, and the time in which the comet passed. They were by these means enabled to identify the star and determine its place, and then to determine the place of the comet. Observations were again made on the morning of the 8th; and on the morning of the 9th a very rough observation only was possible through the clouds, and then came a series of cloudy days, which rendered it necessary to set about another mode of determining the comet's place. The comet was all the while increasing in brilliancy, until, on the Sunday morning, Mr. Finlay and Dr. Elkin observed it quite plainly by daylight. Towards the afternoon they found it approaching the sun with enormous rapidity, until it was evident that it would actually pass either behind or in front of it. At that time it was impossible to say whether the comet was behind or in front of the sun. They watched it until it approached nearer the sun, and its tail vanished, and there only remained a small round disk, which did not appear to diminish as it approached the sun, but rather to get brighter, and was distinctly visible through the dark glass necessary to use in observations of the sun. The comet came close up to the sun, and Dr. Elkin and Mr. Finlay watched it until it was lost in the wavy outline in passing by the edge of the sun. They continued to watch it until they lost all trace of it, and there were only five seconds difference in time in the observations of the two observers, showing that both must have seen it very nearly, if not quite, to the edge of the sun. The next question was whether it had passed behind or in front of the sun. They therefore made an examination of the neighbourhood of the sun where the comet had disappeared, but nothing was to be seen, so they thought it was possible that it had gone beyond the sun.

APPEARANCE OF THE COMET.

When the comet was first seen it had very much the appearance which many of the comets possessed—a sharp nucleus, and a long retreating tail like a parabolic cylinder; but about the 22nd or 23rd September the comet's head began to do a most singular thing. Its nucleus, instead of remaining single, began to get longer, and then elongated still more, until there were two little nuclei connected by a strong-looking thread between them. Then they elongated still more, until on one morning Mr. Finlay counted no fewer than five of these nuclei extending to the length of a minute of arc, the original nucleus remaining the largest and most brilliant.

In the photograph which was taken by Mr. Ellis, of Rosebank, on the 20th of October, these nuclei are not distinguishable separately from the original large, brilliant nucleus, and the tail is partially divided near its end into two diverging portions, resembling the division of a fish's tail. Four stars of considerable brilliance are distinctly seen through the tail.

DATE OF ANNOUNCEMENT.

The comet was first observed on the morning of the 7th September, and on the 9th September Dr. Gill telegraphed to the Astronomer Royal in England that this comet had been discovered by Mr. Finlay, and giving its position. There were telegrams from Paris and Vienna on the 27th September, stating that a brilliant comet had been seen in a position which corresponded with the place of this particular comet, but this discovery of theirs was nineteen days after it was seen by Mr. Finlay, and seventeen days after the telegram had been despatched by him to England. Through some mischance, however, the telegram was mislaid—and he might say that this was the first telegram of his that had not at once reached its destination—and the first telegrams that reached England on the subject were from Rio de Janeiro, and from the Observatory of the Sultan of Zanzibar. But owing to bad weather in England, the comet was there lost sight of for some time. He had dwelt upon the discovery of the comet on account of his friend Mr. Finlay's connection with it.

IS THIS A NEW COMET OR AN OLD ONE RETURNING?

At the conclusion of Dr. Gill's lecture Mr. Finlay gave some account of the elements of the orbit of the comet, and the rapidity with which it passed its perihelion. The elements of the comets of 1843, 1880, and the present one, were very much like each other, but there were some slight changes, and the intervals were so unequal that he was decidedly of opinion that this was not the return of a comet. In reply to a question by the Chief Justice (Sir J. H. de Villiers), Mr. Finlay said the comet had actually passed through the corona of the sun.

Dr. **WHITTLE** then read a paper on "The Census of 1881."*

FIFTH ORDINARY MEETING.

ROYAL INSTITUTION, 11th December, 1882.

EDWARD DAVIES, F.C.S., F.I.C., PRESIDENT, in the Chair.

Mr. George Alexander Mather was duly elected an Ordinary Member.

Dr. **SHEARER** exhibited the crude materials from which the Superphosphates of Commerce are obtained. These were of two kinds :—1. A Canadian phosphatic rock, known as *Apatite*, in fine, massive hexahedra of an opalescent green colour, and the same intermixed with mica. 2. A *Marl* from Carolina, abounding in organic remains, sharks' teeth, whales' vertebra, coprolites, and conchiferous bivalves.

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* See page 99.

Mr. **John Linton Palmer**, F.S.A., F.R.G.S., Fleet Surgeon R.N., read a paper on "Runes." *

SIXTH ORDINARY MEETING.

Royal Institution, 8th January, 1883.

EDWARD DAVIES, F.C.S., F.I.C., President, in the Chair.

The Rev. **Henry H. Higgins**, M.A., made a communication on "Peripatus Capensis," discovered by Professor Moseley at the Cape of Good Hope, who had recently presented a specimen to the Free Public Museum.

NOTE ON A VAST SEA OF PYROSOMA OR SALPÆ OFF THE ISLAND OF SOCOTRA.

Mr. **John Linton Palmer**, F.S.A., F.R.G.S., read a short extract from a letter from Captain F. P. Doughty, H.M.S. "Constance," descriptive of a vast sea of "Pyrosoma," as seen off the island of Socotra, 20th Sept., 1879.

"This evening H.M.S. "Crocodile" had to stop steaming. Huge banks of Salpæ had risen at nightfall to the surface, choking the condensers, &c., by preventing the water coming through the strainers, so no vacuum would be produced. Afterwards the condensers became heated—the strainers were taken off and cleaned three times, but all attempts to proceed failed. At daybreak the Salpæ sank, the ship was able to proceed 180 miles on her course, but next night had to stop from the same cause. The third night there was no such phenomenon." *

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* See page 143.

The Rev. Dr. STERN read a paper on "Flavius Josephus." †

An EXTRAORDINARY MEETING was held the same evening, the PRESIDENT in the Chair.

The Meeting was held to consider the following revisions in the Laws, as recommended by the Council previous to the issue of a new edition.

Law 9.—Concluding paragraph: "But Members elected after the first meeting in February *shall only be required to pay half the Annual Subscription for the current year.*"

To Read: "shall be required to pay only half the Annual Subscription for the current Session, in addition to the Entrance fee."

Law 54.—"A Member may lay before the Society, with the sanction of the Council, an unpublished Paper or Essay by any person not a Member of the Society."

To Read: "Any person not a Member of the Society may, with the sanction of the Council, read or communicate an unpublished Paper or Essay to the Society."

These were now read and passed for the first time.

SEVENTH ORDINARY MEETING.

ROYAL INSTITUTION, 22nd January, 1883.

EDWARD DAVIES, F.C.S., F.I.C., PRESIDENT, in the Chair.

Mr. Jas. Dowling was duly elected an Ordinary Member.

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* See further under 14th Meeting, page lxxi.

† See page 67.

Mr. **Cowell** exhibited some of the drawings of Old Liverpool from the collection in the Free Library, and a copy of Buck's Panorama of London, published early in the last century.

Mr. H. **Longuet Higgins** read a paper on "The Science of Æsthetics."*

An **Extraordinary Meeting** was held the same evening, the **President** in the Chair, when the changes in the Laws, as passed at the previous meeting, were read for the second time and confirmed.

EIGHTH ORDINARY MEETING.

Royal Institution, 5th February, 1883.

EDWARD DAVIES, F.C.S., F.I.C., President, in the Chair.

Mr. R. C. **Johnson**, F.R.A.S., read a short paper on "The Application of Photography to Stellar Cartography."

The following short paper was read on

THOUGHT READING.

By Rev. Henry H. HIGGINS, M.A.

The limited time at my disposal this evening induces me at once to state my belief that the process commonly known as "thought reading" is characterised by genuine phenomena which are in perfect accordance with the natural laws recognised in the science of Mental Physiology.

We, in this society, have, I may presume, a mere secondary interest in the multitude of complicated, adventitious circumstances usually attending a popular exhibition of thought reading. Such circumstances form the staple of the observations and remarks ordinarily made on the subject. The very simplest case is best suited for our purpose; and one *true* example is as good as a thousand.

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* See page 161.

I will endeavour to define what I understand by thought reading; and then to show that its exercise is compatible with scientific principles. The individual who undertakes to read the thoughts of another is called the operator: he whose thought is read is called the subject. I will call the operator A, and the subject B.

If A know the thought of B by an impression, ever so subtle, received through any of the senses, such as touch, sight, or hearing, then A's knowledge is not gained by thought reading; though B may be perfectly unconscious of having afforded an intimation of his thought to A, in any way whatever.

Probably such accessories to apparent success are used by certain public operators so as in a wonderfully keen and sagacious manner to avoid failures. I have no doubt that there are others who are altogether above such trickery. Of course there is a *rapport* of some kind; or the thing would be a miracle. If it be always a sense impression, thought reading must, I think, be classed with table-turning. But if A, guided by no sensuous impression, can, through *quasi* electric relation with B, proceed to say or do something having an unmistakable affinity with a thought entertained by B, but otherwise unknown to A—*that* is thought reading, of which I shall attempt to show the reasonableness.

All of us remember table-turning. Many men of science said, "the whole thing is an imposture, not to be explained, but scouted." If it had been left to these, I think, mistaken men, table-turning might be in vogue now. For in spite of the thing being scouted, the tables *did* turn, no one knew how. For table-turners were not all impostors, but were themselves deceived. Faraday gave a scientific explanation of the fact, and table-turning died a natural death through atrophy.

I am far from anticipating such an end for thought reading, which may possibly prove to be of some remedial value in certain forms of insanity.

There are, I conceive, called into exercise in every instance of thought reading, two distinct constituents—first the ordinary nerve currents; and secondly an abnormal exaltation of the sensitiveness of some portion of the cerebral system, or sensorium, of A.

First, then, as to the currents. There is no need to invoke the aid of any special psychic or odyllic force. We know that between the brain and every part of the body a most intimate connection is kept up by means of the nerves, along which, as along telegraph wires, currents continually pass and repass. The word current is misleading. We must not suppose that matter of any kind is transmitted; neither is nerve current exactly a wave motion; but it is rather a succession of impulses. Professor Clifford compared nerve current with the motion in a row of card houses, when the end house is shoved against the next. The fall of the whole series is very satisfactory to see; the only drawback being that all the cards must be put up again before the experiment can be repeated.

It seems to me essential that you should form a clear conception of motion along a line without transmission of anything. I therefore reconstructed from memory a toy which was a great favourite with me about sixty years ago, and which will now be exhibited. It may be qualified for introduction to a scientific meeting by being named a "statoract."

It is plain, then, that very active motion may be set up along a line without a particle of matter being transmitted.

If you will be so kind as to imagine the plaques of wood to be magnified molecules, you will the better appreciate Professor Clifford's remark on nerve currents. He says that if we could magnify the molecules 50,000,000 diameters, we might see them falling one against another; but he warns us that we should not, even in that case, be any nearer seeing thought or consciousness.

Nerve current is very similar to that of electricity, but the two are not known to be correlated or convertible; though nerve current is said to be always associated with electric current. Pardon tautology. It is the bane of *lucidity* in many scientific books that the author, aiming at elegance in style, uses two or more different terms to express the same thing. So the reader is set wondering whether the author means the same thing by his various expressions, or wishes to denote shades of difference.

In Dr. Rosenthal's account of M. E. du Bois Reymond's experiment, in which the index of an electrometer is made to move by an effort of the will, it seems probable that electricity, thus associated, is the agent.

I have not space to dwell upon the points of resemblance between nerve current and electricity (see *Muscles and Nerves*, Dr. Rosenthal, International Series, Kegan Paul). But the fact must not be passed by that there is a special physical condition of the brain corresponding with every thought of which we are conscious. During every sustained thought, nerve current is acting in a peculiar way in the brain, and probably affecting nerve current in the hand, and over the whole body. I see a man standing on the weathercock of a tall spire, and my knees knock together. This affection of the nerves, controlling the muscles of the knee, is not dependent on volition; therefore it may be regarded as a constant fact, that a brain condition affects, with greater or less intensity, the nerves over the whole of the body.

Here arises what is, perhaps, the critical question of the whole inquiry.

B is conscious of a thought: simultaneously he has in his brain the physical counterpart of his thought. Is it possible for that physical counterpart to be communicated to another individual, independently of impressions made through the senses? We have now advanced a stage. We have left the metaphysical region of thought, and have turned our attention to its physical counterpart in the brain.

One word before proceeding. When I say the counterpart of a thought, I mean a corresponding physical molecular condition in the brain. If B see a peacock, the image of the bird gets no further than the retina of his eye. Anything less like a peacock than its molecular counterpart in his brain can hardly be conceived. If, in the absence of the bird, B voluntarily think of a peacock, the respective physical counterparts, of the sight impression, and of the voluntary thought, will be identical, or sufficiently alike to be identified. If, now, the counterpart of the brain of B can be reproduced in the brain of A, A will think of a peacock, and so solve the problem of thought reading. I will now quote some brief but very memorable words of Dr. Carpenter, *Mental Physiology*, 6th edition, p. 633:—

"Looking at nerve force as a special form of physical energy, it may be deemed not altogether incredible that it should exert itself from a distance so as to bring the brain into direct dynamical communication with that of another, without the intermediation either of verbal language or of movements of expression."

Omitting much I would like to add here, I would say that, to use Dr. Carpenter's term, the dynamics of B's brain, when he is charged to concentrate his whole mind and keep it fixed on a single thought, must, I should suppose, be in a condition very favourable to observation. This kind of concentration is hard work, and, if prolonged, may be felt to the tips of the fingers.

Reverting to the remarkable resemblance between nerve current and electricity, it seems highly probable that nerve current can act at a distance. The phenomena of induction in electricity are too well known to require more than an allusion. Action at a distance may perhaps be said to be the grand distinctive feature of electricity, dividing it from heat and light, which act not, except through their proper media. Nerve current being a force bearing a wonderful resemblance to electricity: will there be no analogous phenomena of action at a distance in nerve current?

What is the nature of nerve current? We know not; neither, according to Professor Tait, do we know the nature of electricity.

A wishes to know the thought of B; how does he place his own nerve current in relation with that of B?

The respective sensoria of A and B are not brought into juxtaposition, because externally the skull is not sensitive. Operators and subjects have sometimes been charged with laying their heads together: in such cases thought reading is of course metaphorical.

There are reasons why the hand should be used as the instrument for receiving the influence of the nerve current. It is extremely sensitive; but, above all, the brain is well accustomed to acts of discrimination founded on nerve current coming from the hand. A, we may suppose, is blindfolded. Touch any other part of his body with a hazel-nut—he is doubtful: let it be brought into contact with his hand—he is sure. This is a sense of impression. True, but the brain is accustomed to judge what a thing *is* that sends up a message from the hand. The nerve current from the hand goes straight to the thalamus. No light is thrown upon the matter there. So the thalamus sends off the current, like a brush, to the grey cortex of the brain, where the current set up by the little hazel-nut is judged—not round enough for a marble; not heavy enough for a bullet; too hard for a little worsted ball; and so forth, till the conclusion is reached—it is a hazel-nut. Down comes a message to the striated body, to be delivered to the organs of voice—say aloud, "it is a hazel-nut." Such is the ordinary course of a sense impression from the hand.

Let us now dispense altogether with the presence of the tangible object, and suppose that instead of being excited by the touch of a hazel-nut, the nerves in the hand of A are excited by the nerve current in the hand of B whilst he is thinking of a hazel-nut: A's hand will send a nerve message to his brain. Of what kind? Of no kind in particular? Quite incredible. What should particularise it? Its efficient cause, namely, B's nerve current, generated by a brain, the physical condition of which corresponds with the thought of a hazel-nut. It seems to me highly probable that A would become more or less vividly conscious of an action in his brain, which he would be able to interpret as having its source in the thought of a hazel-nut.

The consideration of the second constituent in thought reading—the abnormal exaltation of sensitiveness in the operator, A, must not detain us beyond the time required for a brief allusion to the several stages leading by a perfectly natural gradation to the most highly exalted condition of receptivity. All our examples will be found to illustrate the amazingly extended principle of COMPENSATION in Nature. Take the case of a man born blind or deaf. The absence of a sense damages the integrity of his intellectual power: in spite of which the blind man often has his power of hearing wonderfully acute; and the deaf man often has unusually clear vision. Let us pass on to the ordinary condition of sleep. In sleep, sense impressions are all suspended;

reason, judgment, and even volition are in abeyance: yet in sleep we become conscious of that delicate process, which is ever going on, day and night, and which, when we are awake, *is* unconscious cerebration, or the phosphorescent action of the brain. It is unperceived during the day whilst the senses are active, being overpowered by their stronger impressions; just as the light of the stars is unseen in the clear daylight. The action of unconscious cerebration may sometimes be detected if we are suddenly aroused just at the first commencement of a doze. It is very delicious, and its interruption is exceedingly irritating. In sleep it passes into dreaming, which may or may not be agreeable. In the state of reverie, the train of thought is more coherent, the senses are not wholly paralysed; we see figures in the fire, and the likeness of a whale in the cloud, or something else; but volition is wanting. In somnambulism volition is active, the senses also are in a normal condition; but reason and judgment are suspended, and the sleep-walker crosses a chasm by a narrow plank, heedless of the consequences of a fall; or works a sum in arithmetic, vainly attempted during the distractions of waking hours.

All these states are perfectly natural: we attribute them to no mysterious agency; and though the parcelling out of the reason, the will, the imagination, the judgment; now one, and now another of these being suspended, is very surprising, yet not more so than the phenomena in insanity. Yet sleep, reverie, somnambulism, and catalepsy lead up so closely to the electro-biologised, hypnotised, and mesmerised conditions that why the one class of affections should be less a subject for scientific investigation than the other does not appear.

The subjection of the will to the influence of a ruling thought is the great feature in all these abnormal conditions; it is often attended by extreme sensitiveness towards every thing in connection with the ruling thought. The will is suspended in the subject, and the operator vehemently impresses a ruling thought on his helpless victim. All of us have seen the result a hundred times: I never can see it without a shudder.

Permit me now, in conclusion, to apply these considerations to the phenomena of thought reading recently exhibited in Liverpool, speaking of the operator, Mr. Irving Bishop, as A and his subject as B. A wishes to show that he can read the thought of B. As far as possible A changes place with B. A becomes the subject and will have B for his operator. A first secures that B shall have, for the occasion, a ruling thought, *e.g.*, the spot where he has hid the pin. B is to concentrate and maintain his thought on this one thing. As soon as A has made this provision, A throws off his own will by hypnotising himself. A becomes the helpless subject, and B, with his ruling thought, the strong operator. A knows that B *has* a ruling thought, but A has yet to find out what it is. A therefore puts himself in *quasi* electric communication with B, by means of the hand or the wire; but not with B's ruling thought, which is totally out of A's reach, but with its physical counterpart in B's brain. The two brains become like two electric clock dials.

Considering the nerve energy due to a ruling thought in B, and the utter inability to resist, in a hypnotised subject, such as A has become, it might be expected that A would not only act in accordance with B's thought, but that, so soon as he knew it, A would be in very great hurry to do so; would be very much exhausted after it; and would probably, on returning to himself, be quite forgetful of it.

Before bringing my remarks to a close, I may refer to the thousands of experiments in thought reading, or rather, brain reading, which are now from time to time occurring in private drawing-rooms throughout the country. Most of these experiments have been attended with partial success. Indeed, considering the very rough and deficient way in which these extremely delicate experiments have been conducted, the amount of success I have myself witnessed I regard as surprising. The nerve counterpart in the brain, the foundation of the whole process, can hardly have been sharply defined. A very slight approach to the sensitiveness of the hypnotic state is all that can be attained by being blindfolded, though the thought reader is undoubtedly much indebted to the assiduity of gentlemen anxious to secure the complete bandaging of the eyes—a zeal at which Mr. Bishop must often have smiled. Nevertheless the guesses of the most unprofessional thought readers have led again and again to the often repeated expression, "There must be something in it."

The foregoing remarks have no claim to be regarded as demonstrative or anything more than hypothetical and suggestive. The physiologist will point out in them assumptions unproved and perhaps incapable of proof. The materialist will assert that my "brain counterpart" of thought *is* thought; and will assure me that to speak of thought as anything beyond molecular action is extremely dangerous, mischievous, and ignorant.

One thing let me earnestly disclaim. I have no pretension to dissipate the mystery in thought reading. Only its real mystery is not superficial, a mere nine days' wonder, but a part of the profound mystery of life; a mystery for science, as the ages run, deeply and more deeply to explore, but not to fathom. It is *because it is natural,* that it is admirable and wonderful, and that we may have a reasonable hope that, in time to come, it may prove to be of great value in the benevolent and Christian science of Mental Therapeutics.*

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* The reader is referred to the Report of certain Experiments in Thought Transference, page 177 of this volume.

NINTH ORDINARY MEETING.

ROYAL INSTITUTION, 19th February, 1883.

EDWARD DAVIES, F.C.S., F.I.C., PRESIDENT, in the Chair.

Mr. Gilbert M. Steeves was duly elected an Ordinary Member.

The Rev. W. T. SOUTHWARD read a paper on "The Theætetus of Plato."

TENTH ORDINARY MEETING.

ROYAL INSTITUTION, 5th March, 1883.

EDWARD DAVIES, F.C.S., F.I.C., PRESIDENT, in the Chair.

A paper was read on "Some of Shakespeare's Forgotten Associates and Contemporaries," by the Rev. S. FLETCHER WILLIAMS.

ELEVENTH ORDINARY MEETING.

ROYAL INSTITUTION, 19th March, 1883.

EDWARD DAVIES, F.C.S., F.I.C., PRESIDENT, in the Chair.

The Rev. E. C. Selwyn, M.A., was duly elected an Ordinary Member.

The Rev. H. H. **Higgins** exhibited, and made some observations upon, a remarkable specimen of the Melon Shell (*Melo-Georgina*), recently added to the Free Public Museum.

Mr. **Isaac Roberts**, F.G.S., F.R.A.S., read a short paper descriptive of a new Planet Indicator designed by himself.

Professor J. **Campbell Brown**, D.Sc., next read a paper on "The Synthesis of Indigo."

TWELFTH ORDINARY MEETING.

Royal Institution, 2nd April, 1883.

EDWARD DAVIES, F.C.S., F.I.C., President, in the Chair.

Mr. **McLintock** read the following Notes on "Patina," with special reference to the Bronze Statues in front of St. George's Hall:—

PATINA.

By R. McLINTOCK.

A subject of frequent remark, and of still more frequent regret to lovers of sculpture, is the hideous blackness which settles upon all modern bronze statues exposed to the open air. Ancient bronzes seem not to have been liable to this disfigurement, and after having been neglected, and in some cases buried, for centuries, they are found with a beautiful surface, and a colour which is due to neither paint nor dirt, which varies through all the shades of yellow, brown, and green to absolute black—but a bright black, according to the composition of the metal. This surface is called *patina*.

Webster's *Dictionary* defines patina as a kind of rust produced on bronze by being buried in certain soils. This is partly right and partly wrong. Patina is a kind of rust—that is to say, it is caused by oxidation of the metal; but burial is not a necessary condition for its production, as we may see any day by the French bronzes with which we decorate our dining rooms. These—of course I speak of the genuine bronzes, not of the base imitation known as zinc bronze—these are as truly covered with patina as any of the antiques in our museums, although it is not supposed that the latter received their coating before leaving the workshop. This being recognised, the question naturally arises, why are the monumental bronzes of our century not turned out either with the coating of patina ready made, or capable of producing it themselves like the ancient bronzes? For patina, artificial or natural, is only washed clean by heavy rain, while our modern out-door bronzes get a fresh coat of dirt from every shower. And it is not in England alone that the out-door bronzes become coated with soot—it is the same on the Continent.

Above twenty years ago the subject had attracted attention in Germany, and a committee of artists and others concerned with the production and preservation of bronzes was got together in order to try and discover wherein lay the difference between ancient and modern bronzes. This committee has recently published for the *second* time the result of its researches, of which the following is a summary:—

It was established by experiment that a good patina was induced wherever a bronze statue was subject to friction enough to remove dirt and slightly to polish the surface. In a church at Innsbruck there are a number of bronze statues, remarkable chiefly for the badness of the metal and their size. They stand on low pedestals, and in general are as black as any of our out-door statues, but wherever a limb or a fold of drapery projects so as to be touched by the clothing or hands of the passers-by, there is a beautiful patina, bright and clean. One of the statues represents a lady, and most exceptionally there is a good patina on the breast of this figure. On examination it is found that that part had been finished with a smooth surface. These facts suggest how the question is to be answered. Dust and dirt are the great enemies of patina. All metal workers know that dust and dirt will adhere to a rough surface; and yet all modern bronze statues are finished with a rough surface. Why is this? It is that the artist has ceased to be both modeller and founder; he works only in dull clay, and is, therefore, unaccustomed to the glitter of metal, which, especially when the metal is new, is not quite pleasant to the artist's eye. He therefore has it left rough from the casting, or even chiselled rough. The appearance is improved for the first few weeks, but afterwards we know what the effect is—and this afterwards is to last for ever.

If the facts are as I have stated them, the course to be taken is plain. The statues already in existence ought to be carefully freed from their coats of soot and dirt, and afterwards receive a little gentle friction regularly until a patina is established. This will be hastened by the use of a little oil, but the surface must not be left greasy, or it will catch the dirt as badly as before. New statues ought to be turned out with their surfaces all smooth and bright, unless an artificial patina is produced and time taken by the forelock. The objections to this course are simple and easy to foresee. They are the glitter and the additional expense. Well, the glitter is only for a time; a few weeks will suffice to dim its lustre, and we may well put up with a few weeks, or even months, of over-brightness, if so we may escape the after eternity of soot. I remember a proposal made a few years ago, that bronze statues should be gilt, so that a good down-pour of rain would clear off whatever dust and soot might have lodged on them, and render the statues as bright as on their inaugural day. Of course the artists would never consent to that; and yet I think an eternity of glitter would be better than an eternity of dirt. As for the expense, I do not think it need be seriously discussed. Corporations or individuals who can pay for bronze statues at all will not find it very hard to pay a little extra for the assurance that their things of beauty will be joys for ever. To continue the present practice—supposing that what I have just said is well established—will be a fine example of "Penny wise and pound foolish."

Mr. G. H. **Ball** also read a short paper on the "Overflow of the Nile, and the System of Irrigation in Egypt."

Mr. **George Henry Morton** followed with a paper on "Colour Harmony." *

THIRTEENTH ORDINARY MEETING.

Royal Institution, 16th April, 1883.

EDWARD DAVIES, F.C.S., F.I.C., President, in the Chair.

Dr. **Symes** exhibited specimens of Kola Nuts (*Stercularia acuminata*), and made the following observations:—

Kola Nuts are not new. So long ago as 1865 Professor Daniell directed attention to them as a product of tropical West Africa, and as an important article of commerce along the whole coast line from Sierra Leone to Angola, south of the equator. They are used by the natives not only as a luxury, but in a complimentary manner, and as a means of opening up peaceful negotiations between the different tribes. As an act of courtesy they are given to strangers, who soon acquire a liking for them.

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* See page 219.

About 1866 a small consignment came to Liverpool; they were in a good state of preservation, and somewhat lighter in colour than those recently imported. They are considered to have more value when in an undried condition, and the specimens I have here this evening have been so preserved by rolling in damp earth and keeping in a covered jar; since, however, they are very liable to spoil, they are mostly sent over dry. Professor Attfield examined these nuts chemically, and found that in the dry state they contained 42 per cent. starch, 10 per cent. gum and sugar, and over 6 per cent. albumenoid substances. He further confirmed Professor Daniell's experiments, and showed that they contained 2 per cent. caffeine or theine—a highly nitrogenous substance. It would, therefore, appear that the reason why the Aborigines so largely use them is that they compensate in some measure for the deficiency of animal food.

Recently, they have been advocated as a remedy for dipsomania, and if they possess real value in this respect, it must be due to the presence of this caffeine—the proportion present being equal to that found in the best samples of coffee. Where the will of the patient is exercised in a direction favourable to the remedy, I have no doubt that they will prove valuable.

The Rev. H. H. **Higgins** exhibited a rubbing of an ancient cross in the churchyard of Grange-over-Sands.

Mr. **Walthew** exhibited a Japanese work, containing a series of illustrations representing the herbaceous plants of Japan.

Mr. A. H. MASON read a paper on "Perfumes, Odours, and Flavours." *

An EXTRAORDINARY MEETING was held previous to the above meeting, the President in the Chair, when the following new law was passed for the first time, on the recommendation of the Council. Moved by Dr. CARTER, and seconded by Mr. RICHMOND LEIGH, that "Ladies are eligible to become Members, with the same duties and privileges as other Members."

FOURTEENTH ORDINARY MEETING.

ROYAL INSTITUTION, 30th April, 1883.

EDWARD DAVIES, F.C.S., F.I.C., PRESIDENT, in the Chair.

Mr. RICHARD STEEL was unanimously elected President for the term of the next two Sessions.

A paper by Miss HEATH on "The Structure of the Polycarp and the Endocarp in the Tunicata" † was read by Professor HERDMAN.

The following communication was then read:—

REPORT UPON THE ORGANISMS FOUND IN A SAMPLE OF WATER FROM "MILKY SEA," NEAR THE ISLAND OF SOCOTRA, IN THE INDIAN OCEAN, BROUGHT BY CAPTAIN JACKSON TO THE LIVERPOOL FREE MUSEUM.

By PROFESSOR HERDMAN, D.Sc.

A SMALL bottle, containing about six ounces of a pale brownish fluid, and labelled "From the Milky Sea near

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* See page 195. † See page 185.

Socotra," was sent to me for examination some weeks ago by Mr. Moore. I have since received from him the particulars as to the history of the fluid from the notes of the collector and donor.

These notes are to the following effect:—Captain Jackson, of the "Diomed," whilst steaming along the north coast of the Island of Socotra, about five miles from land, on the 12th August, 1882, at 9 p.m., the night being dark and hazy and no moon visible, noticed that the sky to the eastward suddenly brightened as by a rising moon, and that a thin luminous streak had made its appearance upon the horizon stretching north to south. This gradually widened as the ship steamed towards it, and about 9.30 the ship passed almost instantaneously from the usual sea water into what appeared a sea of milk. Captain Jackson describes at length the effect produced, and speaks of the water as being "luminous" as well as "milky." The vessel was completely surrounded by the luminous water, which made the sky appear of inky blackness above, and gave the sea, which was really at the time moderately rough, the appearance of a dead calm. The ship appeared to be stopped. Small pieces of seaweed floating past stood out dark and clearly defined in the water, and could be distinctly seen and distinguished some sixty yards away. This lasted until about 12.30 a.m., when the ship passed out of it again almost as suddenly as she had entered it, and the sea and the sky were as before. At 10.30, and when the sea was at its brightest, three bucketsful of water were drawn from over the side, and then carefully strained through a silk handkerchief, the luminous residue being carefully lifted out with a tablespoon and put into a bottle with about three glasses of whisky. That was the bottle sent to me by Mr. Moore.

Captain Jackson further notes that the luminosity was not confined to the surface, since the water brought up by the deck-pump, the suction-pipe of which entered the sea at a depth of about twenty feet, was exactly the same as that drawn in the buckets, "except that the luminous bodies were all broken up in their passage through the pump."

On examining the bottle of whisky and sea-water, I found that there were a number of fairly well-preserved organisms representing nearly all the great invertebrate groups of animals. The following is a list of those I observed :—

Peridinium.—A good many specimens of *P. tripos*, and a few of two other forms.

Vorticella.(?)—Several colonies of stalked peritrichous Infusoria allied to *Vorticella;* two forms were noticed.

Radiolaria.—A few specimens of *Heliosphæra*, also an *Acanothometra.*

Medusæ.—Two or three small specimens, all more or less injured. They are probably medusoid gonophores.

Echinopædium.—A well-preserved specimen of the *Bipinnaria* stage in the development of an Asterid.

Sagitta.—Eight large specimens and a few small ones.

Copepoda.—Many specimens of same minute Copepods, and also several *Nauplii*, probably of Copepoda.

Phyllopoda.—Two specimens of a phyllopod Crustacean.

Appendicularia.—Three specimens of a short-bodied form, probably *A. flabellum.*

Doliolum.—Two small specimens of what is apparently the sexual form of *Doliolum denticulatum*, Quoy and Gaimard.

Salpa.—Two small specimens of *Salpa mucronata*, a sexual free-swimming form.

Mollusca.—Some small, probably embryonic, Gastropod shells.

There were also a number of Diatoms (*Coscinodiscus,* etc.), a few long hollow filaments (probably *Algæ*), and a piece of vegetable tissue consisting of epidermis with stomata.

This list of organisms does not to my mind satisfactorily account for the luminosity or milkiness. In the first place, no one of them is present in any quantity unless it be the Diatoms; and, in the second place, none of them are pre-eminently luminous organisms. I thought at first the *Sagittæ* might have been the cause, as they form one of the most striking objects in the bottle, but I have not been able to hear of any observations on them as a source of luminosity; and Mr. Murray, director of the "Challenger" Commission, to whom I wrote on the matter, answers "that he never saw *Sagitta* luminous, except when decomposing in a jar."

Mr. Murray has kindly supplied me with some information in regard to the causes of luminosity—a subject which he has had exceptional opportunities of studying during the "Challenger," "Knight Errant," and "Triton" expeditions.

These causes seem to be mainly as follows:—

1st. Large phosphorescent bodies, such as *Pyrosoma*, *Salpa*, *Medusæ*, and *Ctenophora* swimming in shoals.

2nd. Enormous quantities of certain small Crustacea. Dr. Collingwood, in his work on the Chinese seas, mentions this cause; and Mr. Murray, speaking of his experience during the "Triton" expedition, says that "at night great stretches of the sea were like milk, owing to the light given out from the so-called supplementary eyes of *Thysanopoda norvegica*, Sars." This is a schizopodous Crustacean, with eight accessory eyes, and Mr. Murray says that the light from these eyes "seemed to be produced at the will of the animal." He also mentions that some Copepoda have a similar light-producing power.

3rd. Diffused luminosity, or phosphorescence, as it is usually called, is caused around shores by *Noctiluca*, and in the open sea by *Pyrocystis*.

4th. During the "Challenger" expedition, it was discovered that a milkiness in the sea might be caused by an inorganic precipitate, possibly of sulphate of lime. The following extract from Mr. Murray's notes tells all that I have been able to find out about this matter:—"We were told that the sea was milky for weeks at Banda, at some seasons, and when near Banda we got water from a few hundred fathoms depth which contained a white precipitate. We, of course, only had a very small quantity to work with, and no analysis could be made. It was certainly inorganic, but whether sulphate of lime or not I cannot say. Alcohol had no visible effect on it."

The milkiness of the sea off Socotra, observed by Captain Jackson, could scarcely have been due to the first of the above causes, since no large phosphorescent animals were observed, the few *Salpæ* and *Medusæ* in the bottle being both too small and too few to have had any great effect. Nor could it have been due to the causes I have placed under the third head, since neither *Pyrocystis* nor *Noctiluca* are present in the sample.

The second set of causes enumerated above, comprises Crustaceans—notably Schizopoda and Copepoda. Now there are a considerable number of small specimens of the latter group in the sample bottle, but whether sufficient to account for the phenomenon it is impossible to say.

There still remains for consideration the mysterious inorganic white precipitate noticed in the Banda seas during the "Challenger" expedition. Nothing of this kind is present in the bottle *now*, but whether, if it had been in the water, it would have remained unaltered after nine months' immersion in three glasses of whisky, I do not know.

The result of my investigation, then, is, that there is nothing in the bottle which is *evidently* a sufficient cause for the observed milkiness of the sea. There are, however, small quantities of various animals which are sometimes luminous, *e.g.*, Copepoda, Medusæ, and Salpæ, and these may possibly have been the cause. On the other hand, the phenomenon may have been due to an inorganic precipitate in the water, which has since been altered or dissolved.

I may conclude by reading the last paragraph of Mr. Murray's letter to me:—"After a calm is the time for grand displays of phosphorescence in the open ocean. The creatures have all come to the surface during the calm, and have probably multiplied. Then when a slight wind comes, or a boat goes through the water, there is agitation, irritation, and light."

Mr. E. Dukinfield Jones, Corresponding Member, next read "Notes on the Metamorphoses of Brazilian Lepidoptera, second series." *

The following notes were then read:—

REMARKABLE DRINKING HABIT OF A BRAZILIAN MOTH. (*Panthera Pardalaria.*)

By E. DUKINFIELD JONES, C.E., *Corr. Memb.*

When rambling about the rocky beds of small streams on the Serra da Cantareira, near San Paulo, I have often been struck by the great numbers of yellow and black moths (*Panthera Pardalaria*) that flew up from the water, as I disturbed them by my presence. On careful examination I found that these moths were resting on the wet stones, in many cases even with a film of water flowing over the spot on which they had settled, and were all engaged in sucking up the water through the proboscis (I can hardly call it drinking, for no imaginable thirst could account for the enormous amount of water sucked up), and this water was passing through the moths, minute drops forming on the tip of the abdomen and falling off as formed. I timed several specimens, and found the average rate was fifty drops per minute. I have observed the same individual remain in the same position with the action going on unceasingly for three hours; and in all probability it had been there some time before I observed it, and remained after I went away. But even in this length of time the quantity of water passing through the moth was enormous in proportion to its size. The drops I did not actually measure, but they are probably between one and two millimetres in diameter. Taking them to be 1.5 millimetres in diameter, the total amount of water in the three hours was 15.84 cubic centimetres, or almost exactly a cubic inch. This quantity is equal to about 200 times the volume of the body of the moth!

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* See page 227.

The *tibiæ* of the hind-legs are very thick, and are armed with long hairs, that by their capillary action prevent the moth being immersed in the water. I have often seen one of them knocked down by a little spurt of water splashing over the stone on which it was standing, and it recovered itself immediately without being wetted in the least.

Upon my return to Brazil, I shall try to measure exactly the amount of water passing through one of these moths. And it would be interesting to find out what is the object of this excessive drinking. Can it be that the moth extracts nourishment from minute particles of organic matter contained in the water?

I may remark that the water of the streams where I have observed the moth is very clear and pure.

DO BIRDS EAT BUTTERFLIES?

BY E. DUKINFIELD JONES, C.E., *Corr. Memb.*

I HAVE been requested by the Rev. H. H. Higgins to read a paper before this Society upon the above question, which is one of very great interest as bearing upon the subject of mimicry. I regret that I have not accumulated sufficient evidence on the question to enable me to speak with any authority upon it; though, perhaps, this want of evidence may be taken as tending to a certain extent to a negative answer to the question. During the whole of my residence in Brazil, in all amounting to eight years and a half, I cannot call to mind a single case of a bird that habitually devours butterflies, though I may have, now and then, seen a "scissor bird" or sparrow snap at a passing one, as we sometimes see our English sparrows do. But my opinion is that birds do not devour butterflies to an extent at all sufficient to account for a protective colouration of their wings through the action of natural selection. To decide the question, either positively or negatively, however, it will be necessary to make a long series of careful observations, paying particular attention to the matter on all available occasions, and making notes of everthing bearing upon the subject, a task which I shall willingly impose upon myself upon my return to Brazil.

Mr. T. J. MOORE exhibited, and read notes* on, the following recent additions to the Free Public Museum :—

An adult male, and adult female and fœtus, of the Aye-Aye, *Chiromys madagascariensis*, preserved in spirit, and purchased of Mr. James Porter, Fenchurch Street, London, for the purpose of mounting both skins and skeletons of the adult. Specimens of the rare Siamang Gibbon, *Hylobates syndactyla*, and of the White-handed Gibbon, *Hylobates lar*, of the Malay Peninsula, also preserved in spirit, and presented to the Museum through Surgeon-Major S. **Archer**, Corresponding Member.

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* These notes are reserved until the mounting of the specimens of Aye-Ayes and Gibbons is completed.—T. J. MOORE.

Specimens of the Gibbons, or Tailless Apes, are rarely seen alive, especially of the Siamang; the habits of which in confinement (on board ship) were most fully and graphically described by the Society's Corresponding Member, Dr. **George Bennett**, F.L.S. of Sydney, in his *Wanderings*, published in 1834.

Mr. **Moore** also exhibited specimens of the Steamer Duck, *Micropterus cinereus*, presented to the Museum by Mr. F. Buchner, of the Pacific Steam Navigation Company. These birds are remarkable from the fact that the adult birds and young birds had been regarded as distinct kinds until it was proved by Dr. R. O. Cunningham, author of *Notes on the Natural History of the Straits of Magellan, made during the Voyage of H.M.S. Nassau*, 1866–69, that they were identical in kind, and that the adult birds lose the power of flying, which they make up for by most vigorous paddling through the water with their wings as well as their feet; whence their name of Steamer Duck, suggested by the resemblance of their movements to those of the paddle-wheeled steam-ships in use when they were so designated.

Mr. **Moore** also exhibited the following illustrations of the *Teredo*, or Ship-worm, and its ravages, collected, mounted, and forwarded for exhibition by Capt. J. H. **Mortimer**, Associate of the Society, and belonging to his private collection.

"Two specimens of Wood, taken in 1874, from Oregon Pine Wharf Logs, San Francisco," showing *Teredo* borings of large size.

"Large specimen of *Teredo palmulata,* 1874, from the same," nearly nine inches in length, as contracted in the spirit."

"Specimens of *Teredo navalis,* in sitû, from Brooklyn, N.Y., Wharf Logs, April, 1878."

"Specimen of Wood from the same, showing *Teredo* borings, and ravages of *Limnoria terebrans,* 1878."

Also numerous species of Flexible Corals, many of large size and great beauty, dredged off Singapore, and presented to the Museum by Surgeon-Major S. ARCHER, Corresponding Member.*

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* A representative series of these specimens has been mounted and displayed in an upper Wall Case, in the room in which the Corals are exhibited at the Museum.

THE UNITY OF LIFE.

By EDWARD DAVIES, F.C.S., F.I.C.

THE distinction of living organisms into vegetable and animal is one which, at first sight, appears so obvious, as to explain the almost universal opinion that there is an essential difference between these two typical forms of existence. We speak of the mineral, vegetable, and animal kingdoms, and are in danger of supposing that these divisions are of equal value, and that as real a distinction lies between the vegetable kingdom and the animal, in one direction, as between the vegetable and the mineral in the other. In the latter case the distinction is a real one; no bridge exists from one to the other; no connecting links bind them. So the idea grew up that there was as definite a gulf in the former place. But when it was sought to define an animal and a vegetable, the difficulty of the task became at once manifest. Hence arose various attempts to find distinctive characters for each, and fierce contests have been waged over forms which refused to give such characters, in order to claim them for one or other rival kingdom. One by one these characters have been abandoned, until after power of locomotion, sensitiveness, and other minor points have been given up, the method of obtaining their sustenance, and the chemical reactions which take place in organisms, are the characters which now remain as distinctive, and which are, by many, looked upon as forming a firm basis upon which a wall of division may be built up. In a paper read before this Society some years since, I endeavoured to show the evidence upon which this view depends, and gave what I now consider to be undue weight to the differences which undoubtedly exist between typical forms, but which become faint, and even non-existent, in those which are intermediate. Even in forms which generally conform to the type, the chemical distinctions are sometimes reversed in the most perplexing manner.

In ordinary books which treat of botany or chemistry, when the nutrition of plants and animals is mentioned, the absorption of carbonic acid by plants, and consequent evolution of oxygen, is given as the exact counterbalance to the inhalation of oxygen, and exhalation of carbonic acid by animals, the former being even spoken of as vegetable respiration. Works on chemistry are much greater offenders in this respect than those on botany, though even in these little stress is laid on the absorption of oxygen and exhalation of carbonic acid by plants, except in two of the most important actions of vegetable life, germination of the seed and ripening of the fruit, whilst the constant occurrence of the same action during the entire active life of the plant, is, I think, rarely alluded to except in the most modern and advanced botanical works. In fact, on reading Professor Allman's address to the British Association in 1879, it came as a revelation to my mind that the idea of a simple cycle of life, in which the animal and the vegetable figured as opposite and complementary to one another, must give way to another, which showed that they run in parallel lines; whilst showing a complexity in the life-history of vegetables, of which I was to a large extent ignorant. As in this address I shall go to a large extent in the direction of Professor Allman's address, I will give in his own words the views which he then propounded. He began the portion of the address to which I refer by saying, "All recent research has been bringing out in a more and more decisive manner the fact that there is no dualism in life,—that the life of the animal and the life of the plant are, like their protoplasm, in all essential points identical;" whilst he concluded it with, "One of the most valuable results of recent careful application of the experimental method of research to the life phenomena of plants, is thus the complete demolition of the supposed antagonism between respiration in plants and that in animals."

Since that time I have paid special attention to this subject, and without trenching on Professor Allman's address more than is absolutely necessary, I venture to lay before you some gleanings in this rather out-of-the-way, though important, field of knowledge, together with some deductions from the facts which seem to establish the essential unity of life wherever found; and to show that, however convenient it may be to retain the terms animal and vegetable for purposes of classification, to spend time in discussing, in doubtful cases, to which division an organism should be referred, or attempting to draw a fine line of division, is simply to waste time. Nature makes no such distinctions; even in her well-marked types, if the well-being of an organism can be increased thereby, there seems to be no impossibility in passing from one manner of nutrition to another, or in combining both, if that confers the greatest advantage.

In looking at a tree or other vegetable of high type, it is difficult, at first, to accept the statement that, so far as the greater part of its mass is concerned, it is not alive, or indeed ever was. The main portion of its structure is cellulose, starch, sugar or allied carbohydrates, and with these life does not appear ever to have been connected. Life resides in the albuminous, or more properly nitrogenous, substances which, under the indefinite name "protoplasm," may be looked upon as the physical basis of life. The formless cell contents, and not the formed cell wall or starch granule, is the living thing. The visible must be banished from our consideration, and the invisible, to unaided vision, must be our study if we are to know the true phenomena of vegetable life.

Just so in conchology; at one time the shell or outward envelope was the one thing studied, whilst the living inhabitant was neglected. The collector would show with pride his cabinet of rare and beautiful shells, but knew little or nothing of the living beings that had formed them. Yet the shell is only an accident or appendage, and no natural history of the mollusca was worth much that dwelt solely or mainly on this. Even the formation of the shell is only one of the functions of the animal's life, and to devote attention to that, to the exclusion of all the rest, must be pronounced to be a very imperfect view of its life-history. Yet something like this has been the story of the study of vegetables, and from this one-sided view has arisen the idea of the essential difference of animal and vegetable life.

At the risk of seeming to teach things well known to many of you, I must first give a short account of the processes of vegetable life. The laboratory in which the constructive, or, as Sachs calls it, the assimilative, function of the vegetable cell is carried on, is in minute green granules floating in the mass of protoplasm; these are called chlorophyll. They have the power of manufacturing, out of the inorganic materials, water, carbonic acid, and ammonia or nitrates, with mineral salts, under the influence of light and a suitable temperature, all the materials for the growth of the plant, either carbohydrates or albuminoids. The absorption of carbonic acid seems to be almost entirely performed through the leaves, for although Boussingault believed that the roots could also take in this gas, which is abundantly present in the ground, Corenwinder showed, as far back as 1868, that this view was erroneous, and in some researches made last year by Cauvet, it is shown that the roots of plants exhale carbonic acid freely. The carbohydrates are bodies which, like cellulose, starch, &c., contain carbon, with oxygen and hydrogen in the proportions to form water. The albuminoids contain carbon, oxygen, hydrogen, and nitrogen, with small quantities of sulphur and phosphorus. The formation of all these bodies is attended with removal and evolution of oxygen, and in the majority of plants this is the most conspicuous phenomenon, and the one to which most attention has been paid. But there are other and not less important chemical actions in the plant; the albuminoids, when formed, undergo alterations; they do the work of the plant, and work involves oxidation and loss of substance. As in an animal no muscular action, or perhaps even thought, can be performed without using up some material by its combining with oxygen, and being evolved from the system, so in the vegetable, the vital processes follow the same course, and involve similar waste of material. All the changes of material, once formed by the action of the chlorophyll, whether merely a change of state, or the destruction by oxidation, are classed by Sachs under the name of "metastasis," and it will be convenient to use this word. To the action of formation from inorganic materials he gives the name of assimilation, but I think construction would give a more accurate idea of the process. These actions, construction and metastasis, both go on together during the day; during the night metastasis goes on alone. In metastasis, reserves of constructed material are drawn upon, and can be utilised at a distance from the constructing cell. Thus, if a branch of a growing plant be put in darkness, whilst the rest of the plant is exposed to light, it can go on growing, forming leaves and flowers. The stem and leaves are colourless, but the flowers are normal, with the exception of the calyx, which is like the leaves. In like manner, celery goes on growing in the leaf stalks, which are covered with earth, whilst the leaves above the surface are exposed to light. If there is a sufficient amount of reserve material, as in the case of tulip bulbs, or the rhizome of iris, complete plants, with leaves and flowers, can be produced in the absence of light. In these cases no carbonic acid is absorbed or oxygen evolved, but in doing the work, part of the material is oxidized, and carbonic acid is given off In germination there is a large expenditure of force, new cells being rapidly formed from the reserve material, consequently oxidation goes on energetically, with production of heat and carbonic acid.

This has long been noticed in malting, in which moistened barley begins to grow, insoluble starch is converted into soluble sugar, shoots grow out from the seeds, whilst a loss of weight from oxidation of carbon is caused, which may amount to 40 per cent. No chlorophyll is then present, and therefore construction of pabulum from inorganic materials cannot take place, and oxygen is not evolved; so that in one of the most important functions of vegetable life, the formation of a new plant, the organism acts like an animal, uses already formed material for its food, inhales oxygen, and breathes out carbonic acid, producing heat and force. Again, when the flower-buds begin to expand, and those structures are being developed upon which the formation of a new generation of plants depends, the same chemical reactions occur. If a number of unexpanded flower-buds of a composite plant are put into a bottle, the air is rapidly deprived of its oxygen, so that it will extinguish a flame, both from the removal of oxygen and the production of carbonic acid. This is also attended with production of heat, sufficient to be distinctly perceptible to a delicate thermometer. Here again we have an active state, in which the plant is performing new functions, and the animal side of the organism distinctly asserts itself. But it cannot be supposed that only in these two extremes of the life-history of the organism this action goes on. It is certain that, during every stage of its life, there is a chemical action going on, in every respect answering to that which in the animal is almost the exclusive one, namely, living protoplasm utilising ready-formed material, expending force, and so consuming itself in the act. It follows from the foregoing facts that oxygen is essential in the air surrounding a plant. If air, deprived of oxygen, is supplied to plants, the motion of the protoplasm is arrested, and the plant will at last die asphyxiated, just as an animal would do under similar circumstances.

I stated, just now, that in animals an oxidizing action was *almost* the exclusive chemical action which takes place. There is an exception to this, to which sufficient attention does not appear to have been paid. This is the production of fat from starch or sugar, by which a reserve store of combustible material is laid up.

Sugar contains 51·4 per cent. of oxygen, and starch 53·3, whilst neutral fats only contain about 11 per cent. The most striking case of this is in the production of wax from honey by bees. Bees fed only on honey can produce wax in large quantities, and there must be deoxidation on an extensive scale, for honey has a similar constitution to sugar, whilst wax only contains about 7 per cent. of oxygen. The oxygen may be eliminated as such, or it may be utilised instead of atmospheric oxygen in an internal respiration of the bees; but I am not aware if any experiments have been made to show what actually takes place. Other animals can also convert sugar into fat, and it has been remarked that, during the manufacture of sugar, negroes grow fat, notwithstanding the severe labour at such a time, from the consumption of large quantities of sugar. There is a kind of reversion to an early action, to the double function exercised by plants, so that both oxidation and deoxidation are common to organisms in either kingdom, even in their highest members.

So far I have endeavoured to show that deoxidation cannot be looked upon as absolutely distinctive of plants, and oxidation as peculiar to animals, as both actions go on in each. But it may be said that the preponderance of one action over the other is that which forms the distinction. According to this view, a plant is that organism in which the production of material to form its structure from inorganic materials, such as carbonic acid, water, ammonia, or nitrates is the predominant action, whilst an animal is one which must be furnished with materials already formed, which are simply modified, and then used up by oxidation. The distinction thus becomes one of degree, not one of kind. This sort of character is as unsatisfactory as any previously proposed, as the question arises with the greatest force, at what point an organism ceases to be animal, and is rightly called vegetable? But the difficulty is still greater when we consider that a large division of organisms, the fungi, is universally called vegetable. Then we have plants which contain no chlorophyll, do not as a rule utilise inorganic materials, and live almost altogether on the already formed materials of animals or vegetables, dead or living. They sometimes derive their sustenance from decaying organic matter, which they appropriate and modify; they absorb oxygen from the atmosphere, and evolve carbonic acid. At other times they are parasites on living organisms, absorbing their juices, and leading to their destruction by bringing them under the influence of oxidation, so that we may have a plant fulfilling the conditions of what is understood to be vegetable life, and bearing upon it, feeding on its tissues and their contents, another plant reversing all those conditions and carrying on its life-processes on totally different chemical principles. Are we justified, then, in calling fungi, plants, or are they animals? An attempt has been made to remove some organisms from either kingdom, and to call them Protista, neither animal nor vegetable, but something between the two. This, however, has only been suggested for very low forms, Haeckel including among them *Monera, Amœboidæ, Flagellata, Catallacta, Labyrinthuleæ, Diatomaceæ, Myxomycetes*, and *Rhizopoda*.

Fungi are not in this list, though Haeckel seems doubtful whether they should not be, so that if the chemical characteristic is to be held of weight, we must enlarge the list and include more than Haeckel claimed. The tendency of later enquirers has been, on the contrary, to abolish this proposed debateable ground, and to compel its inhabitants to take their places in one or other of the old divisions.

It may be urged that at least some fungi can live, like the yeast plant, on sugar and nitrates, or ammoniacal salts with inorganic mineral salts, and thus to some extent resemble plants in their power of forming albuminoids. I have asked the Rev. W. H. Dallinger if any forms classed as animals are able to live in water with only Cohn's solution as pabulum, and I have been favoured by him with a letter which he has placed at my disposal, in which he says, "As far back as 1875 (see *M. M. Jour.* for that year, p. 190) Dr. Drysdale and I found that not only could the *flagellates* of the septic series live in Cohn's fluid, but that the form known as *Kerona* (*Ehr.*), which was held to be distinctly animal, could also live, and since that time I have repeatedly demonstrated that *Stylonictia pustulata, Paramæcium putrinum, P. bursaria, P. truncatella*, and other forms distinctly declared and proved by Huxley to be animal (vide *Science and Culture*, pp. 176 to end), can with equal certainty live, thrive, and multiply on Cohn's fluid alone. Thus it appears that the last 'distinction' between animals and plants must be held tentatively, and is insecure.

This evidence goes as far as that of the case of fungi, for Cohn's fluid consists of tartrate of ammonium, phosphate of potassium, sulphate of magnesium, and tribasic phosphate of calcium in solution in water.

Another consideration suggested by these facts is whether chlorophyll granules alone can be credited with the sole power of construction. Sachs states positively that "assimilation takes place only in those organs which contain chlorophyll;" and although he is speaking of construction from carbonic acid and water, yet formation of albuminoids from sugar or tartaric acid and inorganic materials involves deoxidation, and is a similar action in that respect.

It is not only in these low forms of life where the insufficiency of the chemical characteristic makes itself felt. Vegetable parasites are found high in the scale of organisation, which fail as completely to fulfil this condition. Take Orobanche, for example; it contains no chlorophyll, it lives on formed material, and derives its food from the juices of clover, ivy, broom, and other plants, yet it stands high among the dicotyledonous plants. Cuscuta, the dodder, for a time draws its support from the soil, but soon finds it easier to rob another plant of its formed material than to make for itself, and it then cuts its connection with the ground, thenceforth leads a truly parasitical life, and it belongs to the Convolvulaceæ. Some parasites are less completely dependent on their hosts. Misletoe contains chlorophyll, and its sickly green leaves no doubt do elaborate cell wall and cell contents, partly from inorganic materials. But it lives to a large extent on borrowed nutriment, and draws away much of the formed material of the tree on which it is stationed. So do to a less extent *Rhinanthus Cristagalli* and some other members of the natural order *Scrophulariaceæ,* which are partially parasitic on the roots of other plants. Some plants again, as *Neottia Nidus-avis,* live on decaying vegetable matter. This is a plant devoid of foliage leaves, and containing no chlorophyll, but able to take up nitrogenous and other organic matters set free by the decay of other vegetable structures.

The researches of Darwin on carnivorous plants are among the most remarkable of the many splendid works for which students of natural history have to thank that prince of observers, whose loss we all feel and deplore. Known as they no doubt are to many, I must give an outline of some of the more remarkable experiments and observations, as they have a direct bearing on my subject. Most of the experiments were made on *Drosera rotundifolia,* one of the Sundews, a common plant on boggy soil. In this plant the leaves are studded with hairs or tentacles, which are tipped with glands, exuding a viscid secretion. When a small insect alights on a leaf, and touches the tentacles, it is entangled by this viscid liquid, the surrounding tentacles begin to curve towards it, and further fasten down the unfortunate victim. The secretion becomes more plentiful and acid, and closely resembles the gastric juice of animals, in containing a substance identical with, or closely related to, pepsin. The insect, bathed in this fluid, is gradually digested, and the digested portions are absorbed; and when all that can be taken up by the plant is removed, the tentacles cease to pour out fluid, they relax their hold, and the dry skin is left to be blown away. Not only can living insects be thus entrapped, but if any digestible animal matter is placed on a leaf, it is in like manner seized and digested. Small cubes of albumen placed on a leaf were digested in about two days; roasted meat, fibrin, gluten, and the principal nitrogenised structures of the animal body were in like manner rendered soluble and absorbed by the plant. On the other hand, carbohydrates, as starch, cellulose, and sugar, and hard or horny substances, such as nail or hair, are unaffected by the juices of the plant, just as they are by the gastric juice of animals. Another striking analogy between the digestive action of the plant and an animal is, that the secretion, until some digestible substance is offered, contains neither pepsin nor acid. In like manner the glands of the stomach do not secrete pepsin until digestible matter is present. As Darwin says, "There is, therefore, a remarkable parallelism between the glands of Drosera and those of the stomach in the secretion of their proper acid and ferment."

When non-nitrogenous or mineral substances are placed upon the leaves, the tentacles close upon them as before, but as soon as their useless character is found out, the tentacles relax, the digestive secretion is not poured forth, and the particle lies unregarded. The dissolved portion of a nitrogenous substance is absorbed and assimilated with the plant, which as truly feeds upon it as an animal does on the similar matters taken into its stomach.

Dionæa muscipula is another plant chiefly remarkable for the rapidity of its movements, by which insects are caught between the lobes of its leaves. The leaves are covered with glands, which only pour out their secretion when dissolved nitrogenous matter comes in contact with them; damp meat, for example, will act, whilst dry meat is unacted upon. The leaves of *Pinguicula vulgaris* also possess glands which, when excited by nitrogenous substances, pour out a digestive fluid which speedily dissolves insects, meat, albumen, and similar bodies. All the genera and species included in the natural order *Droseraceæ* have this power of digesting animal matters; and as they thus are able to supply themselves with nitrogenous food ready formed, there is diminished need for simpler nitrogenous materials, as ammonia or nitrates. They therefore have but slight roots, and in one genus there are none. The genus *Pinguicula* is not closely related to *Drosera;* and the power is one which evidently can be developed in distant members of the vegetable kingdom.

Those plants which possess digestive powers are closely related to others devoid of it, and they must, on the theory of natural selection, have acquired it. Their protoplasm has therefore attained, in a higher degree, the power of direct absorption of formed materials possessed by all vegetable protoplasm, and has superadded a function of digestion, whereby insoluble animal matters are rendered soluble. There are plants which cannot go so far as this. They cannot digest fresh food, but when, by the natural processes of decomposition, nitrogenous matters pass into soluble forms, they are able to directly absorb them. Thus *Sarracenia* catches insects, leaves them to decay, and then absorbs the products of decomposition. In all these cases the need for direct construction of albumenoids is diminished, and the energies of the plant in this direction will be limited, for the most part, to the construction of carbohydrates.

So far I have endeavoured to show that the true respiration of plants is like that of animals, an absorption of oxygen and an exhalation of carbonic acid, and that the reverse process is merely an exercise of the living functions of the protoplasm, namely, construction. A most important function no doubt, for on it we depend for the return of oxygen to the atmosphere, and it is the only natural means by which this can be done. Still it is only a function of vegetable life, and one which it has been shown may be laid aside. As to the question whether plants can preserve the proportion of oxygen constant in the atmosphere; if the carbonic acid in the air was merely due to the respiration of animals and plants, and their oxidation by decay, no doubt they would; but as vast quantities of carbonic acid are evolved from volcanoes, and produced by combustion of coal, it must increase in the air, unless stores of carbon are being laid up as coal at the present time. This subject has been treated by a former President, Mr. A. J. Mott, and I need not enter upon it.

As the processes of respiration and nutrition are common to animals and plants, another chemical characteristic on which weight has been placed, is the chemical nature of the cell wall. In plants this is almost universally cellulose or an allied substance; in animals it is usually of nitrogenous character. The nature of the enclosing structure, itself dead, and serving principally as the envelope of the living portion of the structure, can hardly serve as a character sufficient to distinguish one great order of organism from another. There is not even uniformity in this character; the cell walls of some fungi not being coloured blue by Schultz's solution, whilst in some diatoms, silica is the main constituent of the cell wall; though some organic matter—whether nitrogenous or not I cannot learn—is present. But the most remarkable fact is that in the Tunicata, portions of the structure are composed of Tunicine, which consists of $C_6 H_{10} O_5$, "a substance isomeric and perhaps identical with cellulose occurring in the mantle of Ascidia, and separated therefrom (from the mantle of Cynthia, for example) by successive treatment with water, alcohol, ether, acids, and alkalies. It then remains as a colourless mass, exhibiting the structure of the original substance. (Schmidt.) Berthelot boils the mantles first with strong hydrochloric acid, and then with potash ley, of sp. gr. 1·28, and washes the residue thoroughly with distilled water."—(Watt's *Dictionary of Chemistry.*) This substance appears to be identical with cellulose in every respect, except a greater stability, it being less affected by acid or alkalies; a difference probably due to its physical state rather than any chemical difference. So that undoubted animals contain the distinctive substance, cellulose, and this means of distinction fails. It is probable that this substance, or a similar one, may be found in other animal tissues when looked for. In organisms whose main feature is construction or assimilation, it is easy to see that unnecessary consumption of nitrogen, the element less abundantly present in an available form, is a thing to be avoided as much as possible. This is done by making the cell wall of cellulose, which only requires the elements found in carbonic acid and water, everywhere abundantly present. A perennial plant differs in one respect from individual animals in that it goes on growing, in some cases almost indefinitely, but the living matter, for the most part, deserts the older portion of the structure, and is carried on to the newer and growing parts of the plant. This again produces a great economy in the production of nitrogenous substances, and is parallelled by the vast masses of coral in which the living zoöphytes cover the exterior, whilst the interior is the remains of past labours, dead calcium carbonate. It may be mentioned by the way that the use of calcium carbonate as an investing material in foraminifera and mollusca, is to some extent imitated among plants in the large quantities of the same substance investing the stems of some species of Chara.

The presence of chlorophyll has been long given up as a distinctive feature in plants, many being without it; still, to further strengthen the position, I would refer you to animals which possess it. Hydra viridis owes its green colour to chlorophyll, and *Convoluta Schultzii*, a planarian worm, when exposed to sunlight, actually evolves oxygen, so that the collected gas contains 45 to 55 per cent. of oxygen. The paper from which I quote is one by Mr. Patrick Geddes, read before the Royal Society of Edinburgh, January 14th, 1882. Starch was found in this animal, and the author includes it with Hydra and Spongilla as "vegetating animals." He also found chlorophyll in a number of other animals, such as Anthea cereus, the green sea anemone, and collecting the gas evolved in sunshine, found it to contain as much as 38 per cent. of oxygen. Velella gave 24 per cent. of oxygen, and Gorgoma 24 per cent. The chlorophyll in these latter animals is contained in special cells whose walls are composed of cellulose, and which contain starch. Hence the author looks upon these cells as distinct organisms merely associated with the animal for their mutual benefit. It is not a case of parasitism, for then the animals would be weakened, whereas the contrary is the case; Anthea cereus probably outnumbering all other sea anemones. These cells can survive the death of the animal, but in the absence of any direct evidence of their introduction into the animal, may it not be the case that they are only modified cells of the animal, the protoplasm resuming a lost power for the benefit of the rest of the structure, by supplying it with fresh oxygen, and removing the carbonic acid and waste nitrogenous matter. Certainly the author's view, as he points out, is in accordance with what we see in Lichens. Here a fungus includes Algæ to make up a compound structure, no doubt to the benefit of both. The fungus, devoid of power to construct organic matter from inorganic materials, must soon perish on the face of a rock, were it not associated with Algæ, which manufacture carbohydrates and albuminoids for it, whilst the fungus forms a nidus for the Alga. No doubt further researches will show which view is correct, and in the meantime the cases of Hydra and others in which there is no doubt, show that structures otherwise animal may contain chlorophyll as an integral constituent, and give off oxygen like a true plant.

The most distinctive characteristic of vegetables is the presence of starch granules of definite forms and sizes. The mere presence of starch or some allied substance, giving a blue colour with iodine, proves nothing, as animals contain such a substance, but in an amorphous form. It is the possession of the defined starch granule which establishes the character. But the test fails as a truly distinguishing one, for fungi do not contain starch at all, and some plants contain, instead of starch, an allied body, inuline.

I have so far confined myself to the consideration of the chemical distinction between animals and plants, and have shown that it fails to establish any evidence of a difference in kind between them. Perhaps I should conclude with this as being the ground on which I am most at home; but as I have taken a title which allows me as much latitude as I like to take, I will give a few more illustrations of the analogies of animal and vegetable life which forbid our drawing a line between them. If we consider the phenomena of reproduction, every form of this most important function found in animals can be parallelled in vegetables. Simple fusion of one individual into two separate and distinct organisms is found in the animal Paramæcium, and also in the vegetable form known as Diatoms. The formation of buds which develop into a complete Hydra, is the usual manner in which vegetables give off branches in all respects resembling the main stem. As a Hydra may be cut into pieces, each capable of forming a complete animal, so vegetable stems, and in some cases leaves, are able, when cut in pieces, of reproducing an entire plant. Rising from these asexual forms of reproduction, we have the fusion of the contents of two cells, to all appearance alike, though possibly there may be differences beyond the power of our microscopes to discover, in Zygnema and other Algæ among vegetables, and Gregarina ranked among animals. Among the higher forms of vegetables, truly sexual reproduction is as much the rule as it is in animals. Darwin's researches have shown us that breeding in and in is as detrimental to plants as it is to animals, and nature is full of contrivances to insure cross fertilisation.

The possession of sensitiveness, or susceptibility to external influences with resulting motion, is a subject on which recent researches have opened a new world of sentient existence. As at one time a few wandering stars called planets were supposed to change their places, and the other heavenly bodies were, by way of distinction, called fixed stars, whilst now modern astronomy shows that the universe is all in motion, and that fixity is unknown, so in the world of plants, the sensitive plant, *Desmodium gyrans*, and a few others, were looked upon as wonderful and exceptional cases of motion, and plants in general were looked upon as impassive organisms, only moving in obedience to external force. Now, we know that motion is the rule, both in the individual cells, where the protoplasm pursues a steady round within its narrow limits, and also in the tips of all young and growing parts of plants, and life is shown here by activity. Darwin, in his work on the Movements of Plants, has shown that gyration is universal in the tips of growing plants, both in the stem and rootlets. A most remarkable example of sensitiveness is shown in the motion of the radicle of Zea Mays. A bit of thin sand-paper fastened to the tip of the radicle on one side produces irritation, and the radicle strives to get away from it by turning in the opposite direction, moving in some cases through a complete circle, and even in one case it made two circles; then the bit of card got knocked off; the tip then resumed its natural downwards course, passed through the loop, thus tying itself in a knot, which soon became tight. In like manner, if the side of the tip was touched with nitrate of silver, the tip moved away, in one case beyond a right angle, clearly showing sensitiveness to pain with consciousness of the direction of the irritating matter, and power to move away, just as an animal would try to get away from some annoying source of irritation. The radicles of plants naturally grow perpendicularly downwards, but if the radicles penetrated through a sieve filled with damp sawdust, they perceived that the air was moister above, and turned upwards through an angle of 50°. Darwin says, "The course pursued by the radicle in penetrating the ground must be determined by the tip; hence it has acquired such diverse kinds of sensitiveness. It is hardly an exaggeration to say that the tip of the radicle thus endowed, and having the power of directing the movements of the adjoining parts, acts like the brain of one of the lower animals; the brain being seated within the anterior end of the body, receiving impressions from the sense organs, and directing the several movements." Another singular instance of the power of movement in plants results in what is called the "sleep of plants," especially in their leaves. These, speaking generally, when they change their position at the approach of night, do so to diminish the amount of exposure of their upper surfaces to radiation upwards. Some hang down, others turn upwards, in others the leaflets of compound leaves close upon one another so as only to expose their under surfaces; but whatever means is employed, the object is to prevent injury to the plant by chill. The end of the stem of a growing plant appears to be always moving in a more or less regular circles or ellipses. This motion, though apparently general, is possessed to very different extents, and reaches its maximum development in twining or climbing plants. Darwin describes this in one case as follows:—"The case of another Asclepiadaceous plant, namely, *Ceropegia Gardnerii,* is worth briefly giving. I allowed the top to grow out almost horizontally to the length of 31 inches; this now consisted of three long internodes, terminated by two short ones. The whole revolved in a course opposed to the sun (the reverse of that of the hop), at rates between 5 hrs. 15 m. and 6 hrs. 45 m. for each revolution. The extreme tip thus made a circle of 62 in. in diameter and 16 feet in circumference, travelling at the rate

32 or 33 inches per hour. The weather being hot, the plant was allowed to stand on my study table, and it was an interesting spectacle to watch the long shoot sweeping this grand circle, night and day, in search of some object round which to twine."—(*Climbing Plants*, p. 6.)

Striking instances of sensitiveness in climbing plants are given in this work. The tendrils of *Bignonia speciosa* are almost straight and sharp at their extremity. "The whole terminal portion exhibits a singular habit, which in an animal would be called an instinct, for it continually searches for any little crevice or hole into which to insert itself." It would insert itself into holes, and then, presumably, finding them not suitable, would withdraw it and try another. A tendril of Passiflora would begin to bend round at the slightest touch of a thread, but the touch of another tendril produced no effect, so that something more than mere mechanical action was shown. The plant apparently knew that to wind round a tendril would be useless.

As movements of plants are produced in parts at a distance from the stimulus, there must be some means of communication from one part to another. In the leaf of Drosera, when a piece of meat is placed on a few tentacles near the side of the leaf, the neighbouring tentacles soon begin to point towards the meat, and move to it with perfect accuracy of aim. The nature of the tissues which conduct the impression was investigated by Darwin, and he came to the conclusion that it was through the cellular tissue, transmitted from one cell to another through the cell walls. We must therefore believe that the cell wall of plants is interpenetrated with living protoplasm capable of receiving impressions from the protoplasm of the cell, and handing them on unchanged to the next. It travels with a slowness very different from the almost instantaneous passage of sensation in animals. This, of course, arises from the want of a nervous system, and not from deficient sensitiveness. The delicacy of this was shown by the minuteness of the particle able to cause motion. Phosphate of ammonia was the most powerful agent, the tentacles being sensitive to the twenty-millionth of a grain. On this Darwin makes the following suggestive remarks:—"With Drosera the really marvellous fact is, that a plant without any specialised nervous system should be affected by such minute particles; but we have no grounds for assuming that other tissues could not be rendered as exquisitely susceptible to impressions from without, if this were beneficial to the organism, as is the nervous system of the higher animals."

Why should we suppose that living vegetable protoplasm should not possess a dim consciousness of external influences, with a corresponding measure of pleasure or pain, if we admit it in the case of low forms of animal life? So there may be scientific truth as well as poetic imagination in Wordsworth's lines:—

> Through primrose tufts, in that sweet bower,
> The periwinkle trailed its wreaths;
> And 'tis my faith that every flower
> Enjoys the air it breathes.
> The budding twigs spread out their fan,
> To catch the breezy air;
> And I must think, do all I can,
> That there was pleasure there.

Experiments have been made on the action of various chemical substances on plants for some time back, and it has been observed that under the action of chloroform or ether sensitive vegetable organs, as the leaves of the sensitive plant, temporarily lost their power of motion, and were narcotised just as animals are. Darwin has carried these experiments to a much greater extent, subjecting the leaves of Drosera to the action of a number of chemical reagents. Most, if not all, the mineral salts poisonous to animals are also fatal to vegetable protoplasm; thus nitrate of silver, perchloride of mercury, arsenious acid, chromic acid, and chloride of copper speedily kill the Drosera. More curiously, prussic acid, although a natural constituent in some plants, was fatal to it. Some organic poisons, such as strychnine, digitaline, and nicotine, are fatal; but others, as morphia, atropine, veratrine, and curare, are innocuous. The poison of the cobra, in like manner, was harmless. Chloroform and ether, acting in a small dose for a short time, act as a narcotic; in large doses they kill, probably, as in animals, by preventing oxidation. Even carbonic acid rendered the tentacles insensible to the strong stimulus of raw meat, showing that this gas, essential as it is for the function of construction, when in excess arrests the processes of vegetable life.

The order of development is towards greater differentiation. The primary forms of living organisms must have had the power of construction, for none but inorganic materials surrounded them. The twofold action of building up organic compounds, and the metastasis of these organic compounds, had then to go on side by side with their opposite forms of chemical action, deoxidation as the means of construction, oxidation as the condition of active life. But when pabulum was once provided, it became possible for organisms to exist, which could simply appropriate the stores thus produced, and in some cases the constructive faculty fell into abeyance, capable at first of resuming its activity, but soon lost entirely. Being thus lost, the enveloping cell-wall became naturally formed of nitrogenous materials, which were most easily taken up by the protoplasm, while the carbohydrates were utilised to supply heat and force to the freer and more active protoplasm, and animals were formed. In other cases the two actions still remained united, and the vegetable world in its myriad forms was developed. But whenever the plant could be benefited by it, the constructive faculty could still be laid aside, and vegetable parasites were produced to prey on other vegetables or animals, or on decomposing animal or vegetable substances. There is, then, no reason to assume more than one original organism, but that one endowed with the double function of construction and life. When we try to account for the existence of this, we are in utter darkness, so far as science can shed a ray of light. What marvellous powers are here, what latent possibilities, to which we have absolutely no analogues in non-living matter. There is here not a difference of degree, but one of kind; no connecting link between living and non-living matter exists; at one bound we pass from the inert motionless matter, with, at the most, power to attract to itself similar matter to form a definite crystalline mass, to living matter with power of construction and development, capable of unlimited improvement in infinitely various directions, of reproducing its kind, and of handing on the lamp of life to endless generations. Yet there is still the underlying unity; various functions may be added or laid aside, development may take place in this direction or in that, but to the living protoplasmic particle we must ever revert. To my mind this endowment of a microscopic particle with energies of which we cannot even imagine the future results, conveys an idea of creative power in nowise inferior to that of separate creations. But when we see the results in beauty and adaptation, how can we doubt that an ever-present controlling mind is directing the development of living forms, and that in Him who first breathed the breath of life into the primeval particle, we and all living things live, and move, and have our being.

THE LAST DAUPHIN OF FRANCE.

By JOSIAH MARPLES.

On a memorable day, notable in history as that on which occurred the greatest calamity of modern times—the Earthquake of Lisbon—was born a child who was destined to attain in her youth the height of human rank, and then, before middle age, to drain to the dregs the cup of bitterness and sorrow, and finally to expiate with her life the wrong-doing of generations of the ancestors of him to whom she was united in marriage. Marie Antoinette, the wife of Louis XVI., and the mother of the last Dauphin of France, had two sons. About the elder one, born in 1781, there is some mystery, which, however, we need not follow, as he died young, and his brother, Louis Charles, Duke of Normandy, succeeded to the Dauphinate, and it is to him that we propose to devote a few minutes this evening.

This Prince was born at Versailles, on March 27th, 1785, and there is a singular omen recorded concerning the event, for it is stated that at the moment when his birth was announced, a crown, which surmounted the canopy of the Queen's bedstead, fell suddenly from its place, and was shattered to pieces. The young Prince grew up a marked contrast to his elder brother, who was a weakly, delicate child, and his appearance gave every promise of a fine and noble maturity, while the recorded anecdotes of his infancy exhibit tokens of a wit and sprightliness above the average. When he was but four years old his brother died, and on the 15th June, 1789, the day following the fall of the Bastille, he was presented to the people in the balcony of the courtyard of Versailles as their future king.

It is not necessary for us to do more than recall the story of the French Revolution, which was far advanced even at the time just referred to; how the King and Queen, with the King's sister, the young Dauphin and his sister, were arrested when trying to escape, and were imprisoned in the Temple, from which only one or two of them were to emerge, except to mount the scaffold to meet a violent death.

This imprisonment we pass over; its details are sufficiently well known to render it unnecessary for us to pain ourselves with their recital, and we come to the month of June, 1793, when matters were in the following position:—The King had been executed on the 21st January, Marie Antoinette and her sister-in-law, Madame Elizabeth, with the Princess, were imprisoned in the Tower of the Temple, and the unfortunate young Dauphin was confined in solitude in a turret, and on another floor. Here he was occasionally permitted, at first, to take some exercise in a kind of outer gallery, surrounded by battlemented walls, the spaces of which were, however, completely filled up with wood-work, so as entirely to screen him from all observation from without. His health was giving way under his confinement, but the poor lad, for whose sufferings one's heart bleeds, was kept a solitary half-starved prisoner.

After the disgraceful tragedy of October 16th, 1793, when his mother was murdered, even the small amount of exercise hitherto allowed him was prohibited, and his gaolers, who dared not bring to trial so young a prisoner, seem to have determined that solitude, bad and insufficient food, and neglect should do the work from which they shrank. He was placed in the charge of one Simon, a drunken cobbler, whom the effervescence of the time had thrown like scum to the surface, and whose coarse brutal nature rendered him an eminently fit weapon for the work of the Committee of Public Safety, whose instructions were, that they did not want the Prince to be carried away, nor killed, nor poisoned, but he was to be "got rid of." The work was commenced, and the boy's health was undermined by neglect, by unfit feeding, by causing him to drink to intoxication, and then by blows making him utter all kinds of blasphemy and disgraceful language. The following description of his state at this time was given by his sister after her escape:—"The poor child lay wallowing in his infected cell, amidst filth and rags. It was swept out only once a month. His sense of feeling was obliterated; he had a horror of the place, and lived in it like an unclean reptile in a common sewer. Nobody came near except at the time they brought him his food—bread, lentils, and a morsel of dry meat in an earthen pot, but no fruit or wine. Such was the food of the child in his lonely cell." * When a more lucrative post was offered to Simon, and he had to resign his unfinished task, he made his adieus in a characteristic manner; he called the child to him, and then felled him to the ground with a blow of his fist, and left him senseless. The Prince, up to this time, doubtless owed his life to Simon's wife, who, though in many respects quite worthy of her spouse, was still a woman, and a childless one, and had some germs of feeling left, which induced her occasionally to soften the brutalities of her husband.

On the removal of Simon it was determined that the poor Dauphin should suffer still further, and even a keeper, or a tutor as Simon had been designated, was refused him. It was decided to try what absolute solitude would effect. He was removed to a smaller room, lighted only by one little window, set in a deep recess and darkened by thick bars. For upwards of six months he remained in this dismal cell; his food was supplied through a revolving aperture, and an occasional voice ordering him to go to bed was all he heard to remind him of the outside world. His room remained with-

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* Lamartine, *History of the Restoration*, Book 11, sec. xvi.

out any attempt at cleansing for this period, and here, in loneliness, filth and darkness, devoured by vermin, fighting with rats for his food, all mental consciousness ceased, and his life became a simple animal existence, devoid of hope and memory.

A change was at hand, however, and on July 27th, 1794, Robespierre and his satellite, Simon the cobbler, fell under the axe which they had plied so freely, and a better feeling prevailed. Laurent was appointed keeper of the Temple, and his first duty was naturally to visit the different rooms in the prison, and see to the condition of their inhabitants.

When the lanthorn was applied to the grating of the door, and the child summoned to show himself, there was no response but a feeble moan, which spoke of life in its lowest ebb. The door had to be broken open, for no keys could be found for it, and Laurent made his way as best he could to the Prince's resting-place; we spare details which cannot be calmly dwelt on, but for our information cull the following passages from his report. "He had the look, not of a fool, but of an idiot," "His knees and his elbows were covered with tumours, the result of long confinement, bad usage and depression of spirits." Laurent seems to have acted kindly to his charge, but did not succeed in lighting up the torch of reason, for it appears from reports that he made, that he still remained in an idiotic condition, and could not be induced to utter a word, either by coaxing, or the offer of toys, &c. Laurent retired from his post on March 29th, 1795. Previously to this time some efforts at reconciliation between the Republican leaders and the representatives of the Royal family had been made, and a treaty had been signed on the 17th January by Charette, the leader of the Vendéans, in which it was stipulated that the Prince and his sister should be delivered into the hands of their friends on the 13th June, 1795.

On the retirement of Laurent, two men, named Lasne and Gomin, were appointed to succeed him; these men were both moderate in their Republicanism, and one, if not both of them, appears to have prepared the way for the escape of their prisoner; first the locks, which made a great noise, were carefully oiled, next the doors of the rooms were left open, ostensibly for the purpose of ventilation, saying that the guard at the foot of the stairs was sufficient. The Prison Commissioners, who visited the prison daily, objected to the latter step, as they would probably have done to the former one, had they known of it. Meantime a general wish was spreading through the country for a more settled form of government, and it seemed as if the poor prisoner had still a chance of better treatment.

The 13th of June, when the Prince was to be given up to his friends, was rapidly approaching, when in the early days of May the keepers wrote in the register of the Tower, "The little Capet is indisposed;" the next day the entry was intensified, "The little Capet is dangerously ill, and there is fear of his death." On the 6th May, Desault, an eminent surgeon, was appointed to take charge of him. He ordered some simple treatment, stated that his patient was sinking from decline caused by his imprisonment, and proposed his immediate removal to the country; a piece of advice which was not acted upon by the authorities; and matters went on without much change till May 30th, when Desault, leaving the Prince, is stated to have expressed fears of his life, though there is no such record in the register. The next day the doctor did not call, but a new commissary, named Bellanger, came, who stayed all day, and sat with and tried to amuse the Prince. On June 2nd, when enquiries were made for the doctor, they were told he had died suddenly on the previous day. M. Pelletan, his successor, was appointed on June 5th, and went at once to visit his charge. It should be remembered that Desault had never formally expressed fears about the recovery of his patient while attending him, but as soon as M. Pelletan saw him, he says, "I found the child in so sad a state that I demanded instantly that another professional man should be joined with me to relieve me from a burden I did not wish to bear alone." On the 7th June he and his colleague visited the prison, where the patient spoke to them, and on the 8th June, according to the official report, the Prince died at a quarter-past two in the afternoon. So, according to the histories, ended the unhappy life of the last Dauphin of France.

Modern researches, however, have revealed some facts which, to say the least, justify one in considering it to be an Historic Doubt * if this be true. On the 8th June, at the very time when the Prince is said to have died, the Committee of General Safety, the Government of the day, issued an order to the police of all the Departments to arrest any travellers having with them a child of eight years old or thereabouts, as there had been an escape of Royalists from the Temple, and this police order was issued before the Committee could possibly have heard of the death of the prisoner. † It may be asked, How could such an escape occur?

It will be remembered that shortly before his recorded death, new gaolers had been appointed, then a new commis-

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*It is somewhat curious to find that France owes its translation of the celebrated book by Horace Walpole, called *Historic Doubts*, to King Louis XVI., whose son was destined to add another chapter to the book.—Ireland's *France for the last Seven Years*. London, 1822, p. 386.

†The Paris correspondent of the *London Atlas* writes thus: "The great fact of the escape of the Dauphin from the Temple is well established by the archives of the police, where is still preserved the order sent out to the Departments to arrest on every high road in France any travellers bearing with them a child of eight years or thereabouts, as there had been an escape of Royalists from the Temple. This order bears date June 8th, 1795, the very day of the death of the child in the Temple."

sary, and then, during the last two or three days, new surgeons. These latter did not know the person of the Dauphin, and naturally accepted the boy shown to them as the Prince, but in their account of the inquest they are careful to guard themselves by saying that the body is "that of a child which the commissaries told us was that of the son of the deceased Louis Capet."* As the last commissary appointed was a personal adherent of the late King, named Bellanger, it is easy to see how the Prince might have been removed and a strange child substituted for him. In fact, an account is given in Ireland's book,† already referred to, written very soon after the occurrence of the events, of a person who had been a soldier, and who was on guard at the Temple shortly before the supposed death of the Prince. As he had once seen the Dauphin six months previously, he asked the gaoler to allow him to be on guard in his room, in order that he might see what change had taken place in him; he was permitted on giving his word not to speak to the prisoner; to his astonishment, when the prisoner sat up, he saw he was much taller than the Prince could possibly be, and quite unlike him, so much so that he says, "I am fully convinced it was not him." He remarked to the gaoler upon the fact, and was told to "go home and keep a still tongue in your mouth, lest you should grow shorter by a head;" and as early as 1800 there appeared in the *New Jersey State Gazette*, of February 11th, the following paragraph:—"It is stated in political circles as a fact, that about two years ago, a Frenchman who had left his country on account of his principles, and resided at Philadelphia, affirmed that he was on the Committee of Surgeons who examined the body of the child said to be the Dauphin, and to have died of scrofula, in the Temple, but having known the Prince while alive, on examining the face of the corpse (contrary to positive instructions), he perceived no resemblance, and was convinced that some artifice had been used to preserve the life of the young Prince."

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* Lamartine, *History of the Restoration of the Monarchy in France*, Book 11, sec. xx.

† *Op. cit.*, p. 27.

This curious state of affairs is confirmed by many things. The English Government, for many years, only treated Louis XVIII., the brother of the late King, as Regent. In France no tomb was ever erected to the memory of the Prince, though in 1816, after the Restoration, Louis XVIII. gave orders for the discovery of his remains, and their reinterment, and he went so far as to have an inscription written; no part of the order, however, being carried out, from reasons which you will probably think sufficient.

In 1798, only three years after the alleged death of the Dauphin, appeared a claimant to his name and rank, one HERVAGAULT. He was a youth of distinguished appearance, and though the son of a poor tailor of St. Lô, in Normandy, his looks were such as secured him numerous supporters. He suffered several terms of imprisonment, at last as an incurable lunatic at Bicêtre. He said he was taken out of the Temple in a basket of soiled linen, and that in his place was left the son of his supposed father, Hervagault. At his trial, the most remarkable fact was that the Bishop of Viviers, who was his strong partisan, stated publicly that the physicians who opened the body in the Temple expressed, in conversation, the same uncertainty which is evinced in the *procés verbal*, where they were unable to testify to the death of Louis XVII.*

In 1815, MATHURIN BRUNEAU claimed to be the son of Louis XVI., and consequently the rightful occupant of the throne upon which the Allies had just placed his uncle. He stated that he had been conveyed from the Temple in a mattress, that he had been seen by several crowned heads of Europe, and especially the Pope, who had not only anointed him as the representative of his royal race, but had placed a private mark upon his body, by which he could be identified. This man had possession, in some way, of numerous facts which justified the strong belief in his identity which many had, and it is said by one residing in Paris at the time of Bruneau's trial, that the widow of Simon, the brutal gaoler of the Temple, "affirmed that she was well aware of his having been rescued from the perilous fate that awaited him; which affirmation she positively attested for a considerable time prior to the trial."* Mr. Ireland, who was a barrister, and from whose work I quote this, says that, though unable to offer any opinion upon this particular person's claims, he has frequently heard from persons intimately acquainted with the events of the Revolution, that there is good reason to believe that the Prince did not become a victim in the prison, as generally accredited. He adds: "With regard to his (Bruneau's) condemnation as an impostor, that circumstance does not in my mind proclaim his guilt; for possession being, according to the old adage, nine points of the law, and diadems not being trifles which fall to the lot of a man every day, it may from thence be well imagined that a person so extremely tenacious of his dignity as the present Christian ruler of France, would not easily be led to forego his tenure, even in favour of the progeny of a deceased brother, though he should present himself in the most unquestionable shape." It is said that Bruneau received his first suggestions from a former cook of Louis XVI. He made his appearance several times before the police courts, and was sent to Bicêtre as a lunatic in 1817, but he was apparently soon released, as too many visitors came to see him, and left him sums of money, which enabled him to deposit a respectable amount in the Bank of France. In 1818 he was condemned to seven years' imprisonment, and ordered to pay three-fourths of the costs of his trial, together with a fine of £120. He died in prison.

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* *Memoirs of the Duchesse d'Angoulême*, p. 389.

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* Ireland, p. 365.

The next pretender of whom I find any record is **NAUNDORFF.** He made his appearance in Paris in 1833, and succeeded in winning to his side Madame de Rambaud, who had been nurse to the Dauphin from his birth to his imprisonment in the Temple, and M. de St. Hilaire, formerly gentleman usher to Louis XVI., of whose sincerity there can be no doubt. It was for a long time unknown where Naundorff obtained all the accurate knowledge which he undoubtedly possessed as to the sayings and doings of Louis XVI. in the Temple, and he had in his possession documents of a nature which induced many to believe that his claims had a genuine foundation. Shortly before his death he explained it to his family, and it then appeared that the Empress Maria Theresa of Germany had a favourite arm-chair, which was sent at her death, in 1780, to her daughter, Marie Antoinette; it was amongst the furniture sent to the Temple on the imprisonment of the Royal Family. After the death of the King, his valet removed the chair to England, where it became the property, first of the Prince of Wales, and then of the Duke of Cumberland. The latter took it with him to Berlin, where it was placed in the hands of an upholsterer to be repaired. The workman engaged upon it discovered, in the horse-hair stuffing, a diamond pin, the portrait of a boy, and some sheets of manuscripts. He sold the pin to a jeweller, giving him at the same time the portrait and the papers, which, being written in French, were of no value to him, a German workman. Naundorff was the jeweller, and he succeeded in making out the papers, and found sufficient in them to induce him to make his claim, the papers consisting of instructions written by Louis XVI. to his son, and he met with much support. At his death his family managed to buy the chair, which the Duke of Cumberland had left behind him in Berlin, and it finally found its way, in 1877, to the Museum of Sovereigns, in the Louvre. In spite of these exposures, Naundorff's descendants still claim their royal title. The following is a notice of the death of one of his sons, from the *Haarlem Courant*, a Dutch newspaper; it is dated Breda:—"On the 13th February, 1878, died, at the age of 35 years, my dearly-beloved son, Ange Emmanuel, the descendant of my husband, the Duc de Normandie, son of Marie Antoinette and Louis XVI., King of France. He served in the navy of His Majesty the King of the Netherlands, as second engineer on board the Curaçao, and died at Welterweden, of brain fever.—Dowager de Bourbon, Duchesse de Normandie."

A brother of the above, who calls himself Prince Adalbert de Bourbon, is an officer in the Dutch army.

Richemont, the next pretender of any note, claimed that he had been removed in a basket of clothes by Madame Simon. He succeeded in obtaining an interview with the Duchesse d'Angoulême, his supposed sister, but he was unable to convince her of his identity. Had a little closer attention been paid to the earlier parts of his story, it is probable he would not have deceived so many as he did. Madame Simon had quitted the Temple long before Desault visited the Prince, and as Desault knew his patient well, he could not have been deceived by a changeling; and yet if Richemont was removed by Madame Simon, this difficulty must be faced.

In March, 1869, died at a Trappist Convent in the Department of the Deux Sevres, in France, an old monk, who undoubtedly bore a strong facial resemblance to the Bourbon family. He never publicly claimed to be the Dauphin, nor did he ever trade upon his position as such, his story being that when he first arrived at the convent, when a child, a casket was placed in the hands of the superior, with a strict injunction that it should not be opened till the death of the new monk. As nothing has been heard of the contents of the casket since his death, it is reasonable to suppose that it contained no papers of any moment.

There are two other claimants to whom our attention should be directed. We will take first one who for many years resided in England—AUGUSTE MEVES. His sons published, in 1860, a book entitled *The Prisoner of the Temple*, but a careful study of its contents does not justify us in accepting its statements. It gives two distinct accounts of the escape from the Temple, which is in itself suspicious, as only one can be true. Unfortunately, both are highly improbable.

The first story states that Mrs. Meves' son was born in France in 1785—the year of the Dauphin's birth—but after some years of residence in England, this child disappears, and in his stead is found her pretended child, the Dauphin. The story of his substitution is as follows:—In 1794, Tom Paine wrote from Paris to ask Mr. Meves to send over to Paris a deaf and dumb boy, for some purpose of his own. Mrs. Meves takes over the son of one Maria Dodd, who is taken to the Temple, and there substituted for the Prince, who is brought back by Mrs. Meves, and reared as her own child. We cannot learn from this part of the book where Mrs. Meves' own son is, a son whose importance was such, that it was considered necessary to bring him over from France when an infant, in order that he might be baptized in England, * as he was heir presumptive to some English property. The sole reason that can be given for this act on the part of Mrs. Meves is, that she was, in 1784, in the service of the Queen of France, under the name of Madame de Courville-Chroeder, the "Courville" being a Frenchification of her maiden name,

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* *The Prisoner of the Temple*, p. 21.

Crowley, and the "Chroeder," the titular name of her husband, M. Meves von Schroeder. As this story does not give the fate of the son of Mrs. Meves, we may dismiss it at once, especially as her pretended son seems to have been brought up by her in all respects as if he were her real one, and the family never seem to have reaped any pecuniary recompense for their very great sacrifice.

The second story,* said to have been written by Auguste Meves himself, is to the effect that, not being able to find a youth to answer the description sent by Paine, Mr. Meves determined to take his son over, "as no time was to be lost;" that is, that a father would take over and deliver to what he considered certain death, his own son, in order to save a young Prince, in whom he had no personal interest, for he himself was a German.

This arrangement seems to have been made without the consent of his mother, who at this time was living apart from her husband. Later on, Mrs. Meves, discovering the trick that had been played, and fearing for the life of her son, obtained a gift of a deaf and dumb boy, whom she took to Paris, and, in her turn, substituted for her own son, taking the latter to Germany on her way back, where he appears to have lived for the rest of his life, the Dauphin meanwhile, inheriting legacies left to the son, though the landed property, about which there were such great expectations at an earlier period, was left to another, as the testator had what appears to me very good grounds for suspicion as to his legitimacy. We are here asked to believe, first, that the father takes his eldest son, and places him in a situation of the greatest peril, in order to serve a family to whom he was bound by no ties, and then that a mother gives up her deaf and dumb boy, who, if we know anything of a mother's feelings, would be dearer to her than any other of her children, to save the boy who had been given up in so inhuman a manner, but who, when saved, was not thought worth any further looking after; and all this was done at the suggestion of Thomas Paine, the Author of *The Age of Reason,* a red republican, an enemy to royalty in all its phases, and a member of the French National Convention, by whose orders the young Prince was kept in prison. If it is necessary still further to refute so lame a story as this, we have the materials to hand, for in 1880, an article on Tom Paine and the French Revolution appeared in *Scribner's Magazine,** in which it is shown, by extracts from the French Archives, that from December, 1793, to October, 1794, Paine was in the Luxembourg prison, in momentary expectation of death. It was during the summer of 1794 that Meves said he was rescued; and this we now see was impossible.

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* *Op. cit.*, p. 85.

We have now only one more name to consider—that of ELEAZAR WILLIAMS. We have left his name to the last, as his case appears to present the greatest number of features which might induce one to give credence to the claims made for him. His memoir, under the title of *The Lost Prince,* was published at New York in 1854. It was written by the Rev. J. H. Hanson, who, having heard of the case accidentally, made a thorough investigation of it, and from his book the following account of some portions of his life is condensed. It is only just to Mr. Williams to say that he never traded upon his claims, nor in any way pressed them forward, having been content to continue the work in which he had been brought up—that of a missionary to the Indians. Though for nearly twenty years I have taken notes on this subject, I have never seen any account of his death, and therefore presume that it occurred between 1854 and 1864, when he would be from 70 to 80 years of age.

It will be remembered that the death or escape from the

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* Vol. xx., 721.

Temple took place in June, 1795. In the autumn of that year, arrived in Albany, the capital of New York State, direct from France, a French family, named de Jourdan; this family consisted of a lady, a gentleman, and two children. Though numbers of refugees were at that time arriving in America, this family attracted attention by several peculiarities. The lady and gentleman, though bearing the same name, were not husband and wife, and while the lady dressed with the utmost elegance, and stated that she had been a maid of honour to Marie Antoinette, the gentleman was plainly attired, and acted almost as the servant of the party. About the children there appeared to be some mystery; the girl, the elder, was called Louise, while the boy, who appeared to be nine or ten years of age, was called Monsieur Louis. They were never allowed to go out, but were seen by numerous ladies and gentlemen who called, and it was remarked that the boy never appeared to take much notice of anything. A lady who, as a child, visited them, says there were in their room several articles belonging to the Royal Family of France. After a short time Madame de Jourdan sold off some of these articles, including mirrors, a timepiece, some gilt andirons in the shape of lions, and a gold bowl, bearing the Arms of France, and disappeared from Albany. It is a coincidence, if nothing more, that Naundorff, in one of his statements, in the compilation of which he must have been assisted by some one who was well acquainted with the history of the escape of the Prince, states that a lady of the Court, with a gentleman in attendance upon her, and a little girl, were of the party who took care of the Prince till he was well enough to leave France.

The next chapter in the story has for its scene Ticonderoga, from which place comes the fact that an Indian chief, bearing the somewhat un-Indian name of O'Brien, a thoroughly respectable man, who had been in France, and who could speak French well, states that after his return from France, in 1795, two Frenchmen, one in the garb of a priest, brought an idiotic child to Ticonderoga, at that time an Indian settlement, and left him in the family of an Iroquois chief, whose name was Thomas Williams, and who adopted him. The weak link in the chain of evidence in favour of Mr. Williams' claim is here. There is no direct proof that the child seen in Albany, in the autumn, is the one left with Williams, but the age, the mental and bodily condition, are sufficient to justify us in concluding that they were so; at any rate, we have the fact that Eleazar Williams was a Frenchman born. Into the history of the Williams family, by whom the boy was adopted, we have not time to enter; let it suffice to say that it is well known, is of a highly romantic nature, and extends back a hundred years beyond the time to which we are referring. We next hear that Eleazar (whose name, by the way, appears to have been at first "Lazo" or "Lazau," probably a corruption of Louis, and only converted into Eleazar when he grew up) lived with this family for several years, always the same half-witted child, but improved in his bodily health, and taking part, to some extent, in the wild unsettled life of an Indian encampment. After some time he met with a severe accident, having fallen from a rock into Lake George, and struck a stone under the water, which inflicted a severe wound, but which appears to have restored his mental health, and from this time his memory supplies many links in the chain of evidence. Previous to this the past had but little distinctness, and what there was mingled a hideous face, to which he could attach no name, but only a feeling of horror, with Indians roasting chestnuts round a fire, and dreamlike images of splendid architecture, of troops exercising in a garden, of being in a room surrounded with persons magnificently dressed, and of lying on the carpet with his head against the silk dress of a lady. The change from imbecility to mental vigour did not take place without some sign from the outer world. One of the earliest recollections of his newly-found mind is that of a visit paid to his reputed father's log-house, by two gentlemen, one of whom had every indication of being a Frenchman, who, from his ruffled shirt and powdered hair, bore a splendid appearance, which fixed itself in the child's mind; he sat on a log, and put the child to stand between his knees, and spoke much to him, endeavouring, apparently, to awaken some recollections in his mind, but the boy had no knowledge of the language, and could only catch a word or two, "Pauvre Garçon," being all he understood. After much kissing him, and weeping over him, the gentleman left, but came again next day, and spent some hours with him, during which the boy took him on the lake in his canoe; and before he left he examined the knees and ankles of the boy closely, and again shed tears over him. The mysterious nature of the sympathy of this stranger naturally fixed his visit deeply in the memory of the boy.

Shortly after this visit, and apparently as its result, the boy, with one of his reputed brothers, was sent to a village, called Long Meadow, to be educated by a Mr. Ely. Here the total unlikeness between the two brothers attracted much attention, for while Lazo was fair, with brown hair, hazel eyes, and European features, his brother John had long black hair, and an Indian complexion and formation of face. On being questioned about it, Mr. Ely said there was something connected with it which he should probably never reveal, but he would say this much, that Eleazar Williams was born to be a great man, and he intended to give him such an education as would prepare him for the station. It was noted, after this time, that Thomas Williams, his reputed father, made frequent visits to Albany, always returning with money in his possession, though without any apparent means of obtaining it.

Mr. Ely kept a diary, which is now extant, and in it he recorded, amongst other matters, that it was on January 23rd, 1800, that Eleazar came to Long Meadow, and amongst other effects of Mr. Ely's example was the fact that Eleazar himself began to keep a diary in 1803. In the commencement of it he goes back with a retrospective glance over the time he has been with Mr. Ely since 1800, and it is interesting to notice his gradual, but speedy, improvement in the English language, which he could not speak when they first arrived. The rapidity with which he attained great fluency gives evidence of powers of mind for which his previous history has not prepared us.

It is also curious to compare the diaries of Mr. Ely and Eleazar, as they frequently describe the same events from the different points of a mature mind and a boyish freshness. In 1805 appears an entry—"The ladies requested me to sing French tunes;" and in October of the same year he appears, from his entries, to have made a great impression upon the people of St. Louis, an impression not to be accounted for by anything but his distinguished appearance and his polished manners.

We pass over the intervening portions of his history, though they are full of interest; glancing for a moment at an incident which occurred in the summer of 1818, when Mr. Williams, then a formally-appointed missionary of the Protestant Episcopal Church to the Indians, paid a visit to Montreal, where he had a letter of introduction to Mr. Richards, a Romish priest. After some expressions of regret on the part of the latter that Mr. Williams should have deserted the true Church into which he had been baptised, he continued—"I believe, sir, that you are the gentleman of whom the Abbé de Calonne, of Three Rivers, has often spoken, as a person whose history was written in the womb of mystery in regard to your descent and the cause of your adoption among the Indians of this Province." The curiosity, now for the first time aroused in the mind of Mr. Williams, led him to question Mr. Richards closely, but he could obtain no definite information from him, though before leaving him Mr. Richards said—"You are, I suspect, of higher grade by blood than the son of an Iroquois chief." When Mr. Williams paid a visit shortly afterwards to the scenes of his childhood, he obtained permission to inspect the parochial register of baptisms, and then he found, to his great surprise, that while all his reputed brothers and sisters were duly entered, his name did not appear at all; and further, that the dates of the births of the various members of the family were such as to render it almost impossible that he could belong to it. This was the first time that any serious doubt settled in his mind as to the truth of his received history; but he says he came to the conclusion that he was a French child, who had been given to the Indians by some poor French Canadian family.

We now pass to the year 1841, when the Prince de Joinville, eldest son of Louis Philippe, and at that time heir apparent to the throne of France, paid a visit to North America, and we come to a remarkable difference of statements. Mr. Williams states that the Prince sought him out, and several gentlemen have testified to the fact that the Prince made frequent enquiries as to the residence of Mr. Williams, but the Prince says their meeting was accidental. They did meet, however, and from Mr. Williams' diary is condensed the following account of their interviews, for they were three days together on a steamer on Lake Michigan. When Mr. Williams embarked at Mackinac, the Captain told him that the Prince, who had gone ashore for a short time, had been asking for a Mr. Williams, a missionary to the Indians. Mr. Williams replied that he knew nothing of the Prince, and thought he must be referring to some one else. The

Prince shortly afterwards returned, and was at once introduced by the Captain. Mr. Williams was astonished at the warmth with which the Prince, a stranger, greeted him, and at the consideration shown him; and they conversed much together on the first day of their acquaintance on the history of the French people in Canada and the Northern States. On the next day the Prince commenced with some observations on the French Revolution, and at some length he deduced that it was to the isolation in Europe, caused by the support given by France to the United States, in the war of Independence, that the death of Louis XVI. was due. In the afternoon, the Prince expressed a wish to take Mr. Williams' son to France, to educate him; and hearing that Mr. Williams had an infant daughter unbaptised, offered to be her godfather; but on landing, Mr. Williams learned that the child had died during his absence. When told of it, the Prince sympathised with him, and used these words:—"Descendant of a suffering race, may you be supported in this affliction." During the day, the Prince told him, for the first time, who he really was, and gave him a graphic account of the sufferings of his family; and he concluded by offering him, for signature, a deed, by which, in consideration of an ample and magnificent settlement, with full recognition of his position, he was to surrender his kingly rank and title in favour of Louis Philippe. Beside the deed was laid the old royal seal of France, the use of which would make the deed valid. After much hesitation, Mr. Williams refused to sign the deed, but stated that he intended to remain where he was, poor and needy, but doing what he believed to be God's work amongst his adopted people. The following day they separated, and Mr. Williams says, in his diary, that the adieus between the Prince and himself "were affectionate." It is, perhaps, needless to say that ten years subsequently, the Prince, when challenged on the subject, said he remembered meeting someone by accident on a steamer, with whom he talked a great deal upon the glories of France in connection with the settlement of Canada, but nothing personal. We must confess we would rather rely upon the journal of a minister accustomed to keep such a record, who did not at the time fully realise the effects of the revelation just made to him, than upon the diplomatic reply made by a Prince to an enquiry as to a mission in which he had so signally failed. In November and December of the same year, references to this meeting are made in the journal, in which he expresses his regret that he has ever known the truth, as the fate of his family fills him with sorrow. He closed the entry with the pathetic sentence—"Why was it permitted that I should know this? But to God, the judge of all, I leave it."

In 1848, seven years later, he was startled by the receipt of a letter from Baton Rouge, in Louisiana, in which the information was contained that an aged and respectable French gentleman, named Bellanger, before his death in New Orleans, in the January of that year, had made disclosures to the effect that he "was the person who aided in the escape of the Dauphin, the son of Louis XVI., King of France, from the Temple in 1795; in his transportation to North America, and his adoption among the Indians; all this that he may live and be hidden, and live beyond the reach of his enemies, who had been the murderers of his royal parents; and that the person alluded to as the Dauphin is no other than the Rev. Eleazar Williams, the missionary to the Oneida Indians; and that the gentleman who had the principal agency in the escape of the Dauphin was strictly and solemnly bound by the sacramental oath of the Roman Catholic Church never to disclose, particularly in Europe, the descent or family of the royal youth whom he was about to convey to North America; and that it was not until he saw himself drawing near to a close of his earthly career that he would disclose the secret that had been locked up in his bosom for half a century; and that he would do this the more cheerfully now, without infringing his conscience, because he was in America; and that it may be a benefit to his most dear, beloved, but unfortunate friend the Dauphin. In uttering the last, his whole frame was agitated, and he shed abundance of tears; and that nearly one of his last exclamations was, 'O! the Dauphin, may he be happy and restored.'" In copying this into his journal, Mr. Williams adds, "The intelligence is so improbable that it has no weight nor consideration with me; and thinking at the same time there may be some mistake as to the person, I shall wait patiently the meaning of all this." A week later he mentions having written to one of his friends an account of the contents of this letter; and adds, "It is true I have no recollection of my existence in the world until the age of thirteen or fourteen; what passed with me previous, I am unable to decipher."

It will be remembered, in connection with this, that Bellanger was one of the last Commissioners appointed to the Temple before the removal of the Dauphin, and it may be reasonably supposed that he was placed there in order to facilitate the escape.

In 1853, an old lady died in New Orleans, named Margaret Brown. She had been married three times, and her second husband was secretary to the Count d'Artois, afterwards Louis XVIII., during his exile, a part of which was spent at Holyrood House. Before her death, this old lady was very anxious to have recorded certain facts, which were embodied in an affidavit, duly sworn before a magistrate, From this affidavit tho following is extracted:—"Soon after the arrival of the Duchesse d'Angouléme in England, in 1806 or 1807, my curiosity having been excited by my husband, who told me the Dauphin was not dead, I asked the Duchesse her opinion respecting her brother's fate. The Duchesse d'Angoulême replied to me that she knew he was alive and safe in America. At this period I first heard that a man named Bellanger had carried the Dauphin to America." It had been supposed that the old lady had a monomania on the subject, for she had often made the same statement to others—to some as early as 1835.

It now only remains for us to add a few words as to the personal characteristics and marks which would naturally be looked for, but before doing so it will be as well that we should bear in mind that Mr. Williams never made any claim for recognition, and hence had no object in the fabrication of any marks which might be found upon him, and that his education had been such as to preclude his having any accurate information as to marks, &c., to be looked for. In 1848, the supposition that the Dauphin was still alive, and in America, was first published in the papers, and an article on the subject appeared in *Putnam's Magazine.* Mr. Williams, who was then in New York, superintending the publication of his translation of the Prayer Book into the Mohawk language, became an object of interest to many people in the city. Amongst others to the Chevalier Fagnani, an eminent portrait painter, who had painted from life no fewer than ten portraits of the Sicilian and Spanish Bourbons, and who was therefore thoroughly familiar with the facial characteristics of the family. He was introduced into a room in which was a crowded assembly, with Mr. Williams amongst them. He at once discovered him, and after a careful scrutiny of him, unknown to its object, he was asked what he thought about his being a Bourbon. His reply was, "I don't think at all, *I know;*" and in a letter written shortly after, he says, "I noticed many of the peculiar characteristics which are developed in a greater or less degree in most of the Princes of the House of Bourbon whose portraits I have taken." . . . "I also observed, to my surprise, that many of his gestures were similar to those peculiar to the Bourbon race." Many similar evidences are on record. Some doctors who examined him bore testimony to the presence of marks of severe scrofulous disease on his knees and elbows. A French gentleman saw him, and said that, during the imprisonment in the Temple, Simon had become enraged at something done by the Prince, and had snatched at a towel which was hanging up, and had struck the Prince with it; that in snatching it he had drawn out the nail with it, and that the nail had inflicted some severe wounds on the forehead and nose of the Prince; and he asked to look at Mr. Williams' face, on which he found the two scars, which caused him to say, "What proof do I want more?" Madame de Rambaud, in writing to the Duchesse d'Angouléme, some years before, had mentioned that the arm of the Dauphin had some inoculation marks, one of which was in the shape of a crescent, and as inoculation was not practised amongst the Indians at that time, it was felt that the presence or absence of these marks would be a crucial test. Mr. Williams at once submitted his arm to a doctor, who certified to the fact that his arm "bore two distinct marks of inoculation, one of which is of a semicircular or crescent shape."

It is not necessary for us to go further. The object of the paper has been to place before the Society the fact that the Dauphin did not die in the Temple, and then to give the stories of the principal claimants to what, after all, could prove to be but a barren honour.

ON THE ENUMERATION AND CONSTRUCTION OF POLYEDRA WHOSE SUMMITS ARE ALL TRIEDRAL, AND WHICH HAVE NEITHER TRIANGLE NOR QUADRILATERAL.

By THOMAS P. KIRKMAN, M.A., F.R.S.

The theory of the Polyedra has long had a high place among the problems of mathematical science, and has figured among the unanswered prize-questions of the learned societies of Europe. The last time such question was proposed was in 1858, when the Imperial Institute of Paris offered, with three years' notice, for the *Concours* of 1861, their grand medal of 3,000 francs for any real information about it, in these words (vide *Comptes Rendus*, 1858):—"Perfectionner en quelque point important la théorie géométrique des polyèdres."

The reason why the question was so indefinite is a simple one. Former prize-questions had asked for all: it was desirable to ask for a part. But no learned body in 1858 could venture to frame out of previous knowledge a well-defined scientific question on the subject. For beyond the very ancient enumeration of the five regular solids, and the simple combinations of crystallography, no attempt that I have heard of had been made to scale its difficult and barren crags on any side, except that I had enumerated and constructed the fourteen 8-edra whose faces are all triangles; a contribution very minute to the whole theory of the polyedra. I gave the triplets of summits by which every solid can be drawn with ease upon any one of its triangles as base; but I gave no insight into the secret of symmetry.

The Academy's question, like all previous prize-questions on the subject, brought no answers for the competition of 1861 (vide *Comtes Rendus*). The same prize for the same work was offered again for one year more; but we heard of no candidates, and the glittering medal was at last taken down. Yet the subject must have been pondered by some good heads; for in the *Manchester Memoirs* for 1862, there appeared, from no less distinguished hand than Professor Cayley's, a paper on the triangular-faced polyacrons, in which he found and figured the fourteen solids which I had enumerated and constructed in the same *Memoirs* for 1854: of this, however, as he afterwards informed me, he was not aware when he communicated the paper. He did more: he gave in that memoir a method of enumerating and constructing such solids up to any number of faces: "stopping as to the examples at the same point with Mr. Kirkman; for although perfectly practicable, it would be very tedious to carry them further, and there would be no commensurate advantage in doing so." He showed also that there is a mathematical elegance, and therefore greater ease, in this restricted enquiry, when further confined to triangular polyacrons which have no summit of fewer than five edges, and he gave a method of enumeration and construction for all cases so limited; yet without example of application or result of any kind.

The fault of his method is stated by himself: it is "very tedious." So far as I can see, it involves, as to the limited question, the enormous toil of comparing and identifying scores of repetitions in varying attitudes of by far the most of the polyacrons to be constructed. Professor Cayley touched no more than I had done in 1854, the grand puzzle of symmetry in his solids. (Vide for that *Proceedings* of the Royal Society, Jan., 1863, p. 375.)

The enumeration and construction of all the q-acral

p-edra which have only triangular faces is the simplest and easiest of all problems in the general theory of the polyedra. For any edge of such p-edron, across which lies no triangular section of the solid, being effaced, we have a q-acral (p—1)-edron of which all faces are triangles except one 4-gon. In the tables of the q-acral (p—1)-edra these 4-gons are given with their symmetry; and the number L of all their different diagonals is given. In the same tables is the entry (38) = $M_1 + {}_1N$, the number of all the edges of these (p—1)-edra across which is a triangular section. Wherefore the entire number of edges of the q-acral p-edra to be entered is $L + N_1$, the number N being unaltered, and the change of place of the suffix unit denoting that a delete is conceived to have become an effaceable, thus adding a face. (Vide page 182 of vol. xxxii of these *Proceedings.*) With this number L + N, in its specified parts with known symmetry all in the tables, is given everything required for the full and complete description and enumeration of these p-edra, by aid of the general theory. And after that, as the paper last referred to shows, their unrepeated construction is a bagatelle, compared with what precedes it. For these reasons, I took little interest at the time, and for nearly twenty years after, in Professor Cayley's short paper, except that it was a high gratification to see myself alone associated with a man of his power, to make up the complete list of writers on this difficult subject. Quite recently, however, I have amused myself with looking more closely into his judicious and pleasing limitation of this problem by exclusion of summits of three and of four edges; not without regret at having so long neglected the entire literature given to me in any language of this wide topic in Geometry.

I have studied with much enjoyment, useless as the whole theory is, the separate and independent construction of polyedra having only triad summits, which have neither triangle nor quadrilateral; and this mathematically is one with Cayley's limited problem.

The following considerations prove that these solids can all be reduced by well-defined rules to fundamentals all of one simple form, on which, by the converse rules of construction, they can be built in order without risk of omission, and with repetitions few and all foreseen. Nothing is accomplished in this handling of Professor Cayley's "triangular-faced n-acrons of the third class," which is not done in a more powerful and compendious manner for every kind of polyedron by the processes of my complete theory of the Enumeration and Description of the Polyedra, which was presented to the Royal Society in 1861. But, alas! I can refer to no proof of this in print containing all the steps of the reasoning and the work even for solids of a small number n of faces. Indeed, I have too much cause to feel heartily ashamed of writing that theory; for it was easily proved, without perusal of six pages of it, twenty years ago, to have no scientific value that could entitle it to appear intelligibly in the *Philosophical Transactions*. Hence it has the honour to appear there unintelligibly. The case is very different with this limited problem. This has been selected from that huge heap of questions by a Cayley, and by him learnedly treated of in print; although from a point in my humble judgment far too remote for results. The problem has thus won front rank in science; so that I need not be ashamed of offering a complete analysis and workmanlike solution of it; and this by construction of the solids, not following description and enumeration, but hand-in-hand with them; which, however, makes the selected problem more difficult than it is when dealt with as a part of the great whole. When I say by construction of the solids, I mean that I give definite rules for that construction, at a cost of repetitions in the great majority of cases not exceeding three or four, and in most cases not exceeding two.

1. The n-edra Π_n, which have only triad summits, and have neither triangle nor quadrilateral, are either solids P_n, which have a frame or frames, or solids Q_n, which have no summit 555.

Definition. A frame is a sheet of 5-gons, of which no two neighbours have not a common summit 555.

A frame has one or more summits 555, and has at least three 5-gons.

2. Frames are 3-4-5- or 6-walled. Every frame has a symbol, a contour, and a walling.

A least frame has the least number of walls. Of m-walled frames the least has the fewest pentagons.

3. If a P_n has no frame of fewer than six walls, the least frame it can have has the symbol $s_p = 1_3$, showing $s = 1$ summit, and $p = 3$ pentagons.

The contour of 1_3 is 101010, and its walling is $A_1B_0C_1D_0E_1F_0$, showing that the A-gonal wall has one *ray-point* or summit A55, as have C and E; while B D and F have none, but each a *zero-edge* of the contour, B5, D5, and F5, the 5's being all pentagons of the frame.

4. A_1 in this walling, is no 5-gon; for if A55 were 555, A would be no wall, but a pentagon of the frame. Neither can A_2 or A_3 carrying two or three ray-points be a 5-gon.

The walls B_0 D_0 F_0 may or may not be 5-gons, and they may be $B = 0$, &c., one or all of them, *i.e.*, null walls, being simple edge or edges 55 in no summit 555, but common to pentagons in different frames.

5. Possible symbols with wallings of three and of four walls are—$10_9 = A_2B_2C_2$; $8_8 = A_2B_1C_2D_1$; $9_9 = A_3B_0C_3D_1$; $10_{10} = A_4B_0C_4D_0$.

Possible contours of five and six walls are—$5_6 = 11111$; $6_7 = 20211$; $7_8 = 30220$:

$1_3 = 101010$; $2_4 = 110110$; $3_5 = 020111$; $4_{006} = 201201$; $4_{0006} = 202020$; $5_7 = 030121$; $6_8 = 031031$; $7_9 = 040131$; $8_{10} = 041041$; . . . . $2m_{2m+2} = 0m10m1$; $2m+1_{2m+3} = 0(m+1)01m1$ up to any value of m. It is not difficult to prove that a frame of seven walls is impossible. The pentagons of a $(6+r)$-gonal prismoid (19) may be, not quite properly, considered to be a frame of two walls.

6. If when K—a, L—1, M—b, are each >4,
$s_p = \ldots K_a L_1 M_b \ldots$ be any frame of P_n,
$(s+1)_{p+1} = \ldots (K+1)_{a+1}\ (L-1)_0\ (M+1)_{b+1} \ldots$
is a frame of P_{n+1}; and *vice versâ*.

The transition from the first to the second is the cutting of a 5-gon from the wall L; and we can thus pass (not regularly) from 1_3 to 2_4, 3_5, &c.

The reverse is the effacement of the zero edge $(L-1)5$, (3); and we can thus pass back from a greater frame to 1_3. The reader can easily impose 1_3 on a 6-gon, or 5_6 on a pentagon.

7. The only contour having three units is in the walling $A_0\ B_2\ C_0\ D_1\ E_1\ F_1$ of 3_5, which by the above rule, putting D_1 or E_1 in turn for L_1, gives frames whose symbols are 4_{006} and 4_{0006}, showing the ${}_{00}$ and ${}_{000}$ in the contours. These two and 5_6, when the walls are all 6-gons, have properties sure to strike the student, but not required here.

Since (6) neither K+1, nor M+1 is a 5-gon (4), the above effacement of a zero edge of P_{n+1} cannot introduce a 4-gon on P_n. If $L-1=0$ in (6), the edge of P_{n+1} erased is (55), (3); and 6_1, not 1_1, will replace it in each frame of P_n, separated in P_{n+1} by the null wall; (4).

8. *Movable frames.* The frame $10_9 = A_2B_2C_2$ is movable, if every wall is not less than 8. For removing the frame and effacing ray-points, we have a triangle which can vanish to a point (A—3)(B—3)(C—3), introducing no 4-gon. If any

wall of $10_9 < 8$, the frame is *immovable*, and is written $i10_9$ in the label (12) of the solid. Thus $8_2 8_2 6_2$ or $8_2 8_2 7_2$ is $i10_9$.

9. The frame $A_a B_b C_c D_d$ of four walls is movable, if of the pairs (A—*a*)(C—*c*) and (B—*b*)(D—*d*), one is at least 55 while the other is at least 66: for when the frame is removed, and ray-points effaced, the opposite non-pentagons can lose each a vanishing edge, and we have an edge $A'C'$, or $B'D'$, about which is no 4-gon.

When this condition is not fulfilled, the frame is immovable, and is written in the label of the solid, $i8_8$, $i9_9$ or $i10_{10}$. Thus $8_2 6_1 7_2 6_1$ is $i8_8$; and $8_4 5_0 12_4 5_0$ is $i10_{10}$; but $8_2 7_1 8_2 7_1$ is movable and reducible to two different edges 55; and $7_2 7_1 7_2 7_1$ is a movable 8_8.

10. The frames $A_a B_b C_c D_d E_e$ and $A_a B_b C_c D_d E_e F_f$ of five and six walls, are movable if every difference A—*a*, B—*b*, &c., >4. For, removing and effacing as above, we have a 5-gon or a 6-gon about which is no 4-gon.

If any difference is not >4, the frame is is_p. Every immovable frame has in its walling one or more of 6_2, 6_3, 6_4; 7_3, 7_4, 7_5; 8_4, &c. No frame 5_6, 1_3, or 2_4 is immovable.

11. If 6_4, 7_5 or $(l+2)_l$ is in a walling . . . K_k $(l+2)_l$ M_m . . . . , the $(l+2)$-gon has $l+1$ edges $5(l+2)$, and also edges $K(l+2)$ and $M(l+2)$; for contiguous walls are collateral. The $(l+2)$-gon has thus $l+3$ edges, unless K and M are one and the same K-gon, which carries the $(l+2)$-gon on an edge, on the sides of which it has *k* and *m* ray-points. Such configurations are frequent, but do not embarrass our rules of reduction and construction, for the wallings and contours can always be read on the figure, after every change.

12. *Reduction of* P_n, which has summit or summits 555. A base Π_{n-e} of Π_n is any $(n-e)$-edron to which Π_n can be reduced by one of the rules following, and on which it can be built by the converse rule of construction. Every P_n in our complete tables has a label, showing its faces, its symmetry,

the symbols of all its frames, and the note m_c, meaning c times made, or having c different bases. It is useful to write on the label the explicit wallings of its different immovable least frames.

Every Q_n has a label, showing its faces, its symmetry, its windows and circles (vide 21), its edges ε (20), with m_c. To this may be added, if required for further definition, the number of its summits 666.

The symmetry when complete will show the zones, and the zoned and zoneless poles, whether edges, faces, or summits.

P_n may or may not have both a movable and an immovable least frame. No movable is least if there is a less immovable; and *vice versâ*.

No two configurations are different, if one is either the repetition in any posture, or the reflected image, of the other.

P_n is always reduced at a reducible least frame of it. There are only two irreducible frames (14); and by a least frame in all that follows we mean a reducible least, unless the contrary is made clear.

13. Let P_n have a movable least frame s_p; then every different such least is to be removed (8, 9, 11); each removal giving a different base Π_{n-p+1}.

If on a completed P_n or P_{n-e} a wall common to two frames is diminished or increased by an operation of reduction or construction at one of them, the change of size must be made on P_{n-e} or P_n in the other frame, without alteration of its contour, if its walling is to be given in the label to be written.

Let P_n have an immovable least frame f, whether it has or not a movable least.

If f has no zero edge in its contour, that is, if f be $i10_9$ or $i8_8$, the reduction is made at f by enlarging one of the frame-walls, whose smallness is the only hindrance to the removal of f; (8, 9).

The rule is: Enlarge the extendible least wall, that is, the least wall which has a *delible* edge, by effacing that edge.

Def. A delible edge *ab* of such a wall, whatever be the faces *a* and *b*, is an edge that meets no 5-gon, so that in its two summits *ab*C and *ab*D neither C nor D is a pentagon.

By this effacement in *f*, P_n becomes the base P_{n-1}, and *f* becomes either 10_9, $i10_9$, 8_8 or $i8_8$.

14. It may easily be that *f* on P_n has no delible edge of a wall. Such an *f* is both immovable and *irreducible*; and will be entered in the label of P_n as $ii10_9$, or $ii8_8$; and this *f* counts for nothing in our search for a least frame; (12). Hence if on P_n there is $ii10_9$, and no 10_9 nor $i10_9$, the least frame on it has more than three walls; and if P_n has $ii8_8$, and no 8_8 nor $i8_8$, the least frame of it is 5_6, or else one that has a zero edge in its contour, and P_n is to be reduced by (17), exactly as if it had no irreducible frame, to a base P_{n-1}, which may or may not have a movable least frame. If on the P_{n-1} the irreducible frame of P_n has come to have a delible edge in any wall, the *ii* is replaced on P_{n-1} by *i* in the label; if not, the *ii* is retained and the reduction of P_{n-1} is like that of P_n of which it is the base.

15. All this is clear enough in reduction; but as the P_n which has only an irreducible frame 10_9 or 8_8 cannot be thereat reduced, so neither can it have been thereat constructed. How then was it built?

To consider this: On opposite triangles of a wedge impose frames 10_9. We thus form P_{21}, m_1, the 3-zoned monarchaxine $8^3 5^{18}$, $Z_1 = 670^4 0^3$, $Z_2 = \cdot 30^{8}\cdot$, whose frames are both $8_2 8_2 8_2$. Cut a least wall 7_2 from 8_2. This is the converse of the operation in (13). We thus get P_{22} (m_1) the asymmetric 98765^{18}, whose frames are $i10_9 = 9_2 8_2 7_2$, and $i9_9 = 7_0 6_8 8_1 9_8$, constructed aright at its immovable least frame $i10_9$. Here 8^3, 0^4, &c. mean 888,0000, etc.

Observe that although reduction of a P_n must be effected at a least frame of it, construction on a P_n may be effected at any frame of it, if so that the line or lines drawn shall complete a least frame of P_{n+1} or P_{n+6}.

We can form a P_{23} by cutting off a least wall 6_2 or 7_2 of $i10_9$ on P_{22}, completing $i10_9$ a least frame of P_{23}; or we can cut a 5-gon from the 6-gonal wall of $i9_9$ on P_{22} by the converse of the operation on a zero edge in (17), obtaining P'_{23}, m_1, the monozone 9^2765^{19}, $Z=870^30^4$, whose frames are $ii10_9=9_27_29_2$ and $i7_3=5_06_35_09_29_2$; which is constructed aright at its least frame $i7_3$; (14). If we had drawn another bisector of that 6-gonal wall, we should have made a false construction, not at a least frame, (18), of a P_{23}.

On this P'_{23} we can either construct P_{24} by cutting off a least wall 6_2 or 7_2 in $ii10_9$, making it $i10_9$ having the delible edge so drawn; or we can form on it P_{31}, m_1, the asymmetric $9^28^276^35^{23}$, by cutting away in more ways than one an edge 55 in the frame $i7_3$, and imposing 8_3, thus forming P_{31} by its movable least frame $8_26_18_26_1$ and retaining the $ii10_9$ of P'_{23}.

16. If we impose 8_3 on two opposite faces of a cube, we form either P_{20}, m_1, the triaxine heterozone $8^26^25^{16}$, $Z_1=46^00^40^2$, $Z_2=86^10^30^4$, $Z_3=\cdot40^{4\cdot}$, whose two frames are both $8_26_18_26_1$; or we form P'_{20}, m_1, the triaxine homozone 7^45^{16}, $Z=660^30^3$, whose frames are both $7_27_17_27_1$. Bisecting on P_{20} the 6-gon wall by 55 meeting two walls, we obtain P'_{21}, m_1, the two-zoned monaxine heteroid 9^265^{18}; $Z_1=870^30^4$, $Z_2=230^30$; whose two like frames $i9_9=9_30_09_36_1$ have for a common null wall the 55 just drawn. Cutting off an extendible least wall 8_3 from 9_3 on P'_{21}, from a point in 6_1 by the converse of the rule in (13), we construct the asymmetric P'_{22}, m_1, 98765^{18}; $i9_9=9_37_18_35_0$, $i7_3=8_06_35_09_27_2$. From that wall 8_3 cutting a wall 7_2 by an edge meeting two 5-gons of P'_{22}, we construct by the same converse operation the asymmetric P''_{23}, m_1, $97^26^35^1$, $i8_3=9_27_17_26_1$, $i6_7=9_25_06_26_17_1$.

Next by bisection of the wall 6_1 of $i6_7$, we construct the asymmetric P''_{24}, m_2, $987^2 65^{19}$; $ii8_8 = 8_1 7_2 6_1 9_2$, $i7_8 = 5_0 7_8 5_0 9_2 8_2$; which carries m_2, because $i7_8$ has two different zero edges (17). The first irreducible frames that occur are on this P''_{24} and the P'_{23} in (15). We return to our reduction of P_n (13).

17. When the immovable least frame *f* of P_n has a zero edge in its contour, the reduction is made by effacing that edge (7), thus enlarging that wall. Every different zero edge of every different immovable least frame of P_n gives by its deletion a different base P_{n-1}.

It is easy, but not here necessary, to give an account of the transformations when a wall of a frame becomes 5_a, $a > 0$. Enough, that after effacement as here directed on P_n of any zero edge of a contour, the symmetry and frames of the base can be read on the figure.

The number *c* of different bases Π_{n-c} or P_{n-1} of a P_n is the number of its different movable least frames, plus the number of different ways in which a wall of an immovable least frame of it can be enlarged by the effacements in (13, 14, 17); and m_c will be read on its label.

18. The rules for construction of a P_n are the converses of those for reduction. That is, a P_n is rightly made by imposition on any base of a movable least frame of P_n; that of three walls (5) being imposed on a triangle made by truncation of any summit of the base; that of four walls being imposed in any posture of the contour (5), on a quadrilateral made by cutting away any edge of the base; and that of five or six walls being imposed in any posture of the contour on any 5-gon or 6-gon of the base.

A P_n is also rightly made by cutting from any wall of an immovable, whether *i* or *ii* (13, 14), or of a movable, least frame 10_9 or 8_8 of P_{n-1}, an extendible (13) least wall so as not to make a 4-gon; and rightly made also by cutting off on P_{n-1} from any wall of a movable or immovable frame of five or six walls, whether least frame or not, a 5-gon which shall be a 5-gon of an immovable least frame (10) on P_n. For this last "immovable" we cannot read movable. Such a 5-gon can be cut off by the first constructing line drawn on a (6+r)-gonal *prismoid*. Vide (19).

19. The P_{21} in (15), and the two P_{20} in (16), were not rightly constructed. If you remove a frame from any of them (8, 9), you get for base P_{12} the zoned hexarchaxine 5^{12}, which may be called the 5-gonal *prismoid*.

In any R-gon, draw on the sides R 5-gons to make summits 555 with R more collateral with an upper R-gon. Such a (2R+2)-gon I beg leave to call, if the word is not better employed, the R-gonal *prismoid* $R^2 5^{2R}$. I shall not occupy space by proving what the student who looks into the matter will soon know, that every Π_n is reducible by the rules preceding and following, to a (5+r)-gonal prismoid.

On the prismoid P_{14} we get (18) one P_{15}, a 3-zoned monarchaxine heterozone, and on this P_{15}, a zoneless triaxine P_{16}. On the prismoid P_{16} we get one monozone P_{17}, and on this P_{17} six P_{18}, one 3-zoned monarchaxine homozone, one 2-zoned monaxine heteroid, one monozone, one zoneless triaxine, and two zoneless 2-ple monaxine heteroids. On the prismoid P_{18}, we get one monozone P_{19}, on which we form five P_{20}, one 2-zoned monaxine heteroid, three zoneless 2-ple monaxine heteroids, and one asymmetrical. On the prismoid P_{20}, we get one monozone P_{21}, on which we construct five P_{22}, one 2-ple monaxine monozone, three zoneless 2-ple monaxine heteroids, and one asymmetrical.

If the reader will take the trouble to write out accurately the labels of these solids, he will be a match for most of the difficulties of the subject. The P_{n+e} made by imposing a least movable frame or Π_n are easily registered. If a base has least frame or frames s_p, no greater frame can be imposed but by an operation which destroys all these s_p.

20. When a P_n has either only one frame, with at least one 6-gonal wall, or only two frames, with a common 6-gonal wall, such that the bisection of the 6-gon by an edge $\epsilon = 55$, can destroy all the summits 555 on P_n, we write it $P_n\dagger$, or *crossed* P_n. This disappearance of all summits 555 is possible only when the frame or the two frames are 1_3, 2_4 or 3_5; for no other has all its summits 555 in one 5-gon, whose change into a 6-gon destroys them. Our tables show at a glance every $P_n\dagger$, with its one or two frames and its 6-gonal wall, whose bisection has the effect described. When 1_3 is the only frame, and all its walls are 6-gons, there are, if the frame is not symmetrical, nine bisectors ϵ possible which can destroy the frame. The solid constructed by that bisection is $R\dagger_{n+1}$ (21), a different result for every different ϵ that can be drawn.

The Q_{n+1} so formed has at least two lines $\epsilon = 55$, the ϵ just drawn, and another in the summit 655, to which a 555 has been changed. Both ϵ of a pair meet the same new 6-gon, and neither can be effaced without introducing upon the other a 555.

When our table of $P\dagger_n$ (18) is complete, we mark at the mid-points on each solid, those *different* edges 65 of the contour or contours, edges not having a summit 655, through which a bisector 55 of the 6-gonal wall can be drawn so as to destroy all the 555 on $P\dagger_n$. There will be E_0 of such different edges ϵ drawable, to form so many different $R\dagger_{n+1}$. This E_0 will appear on the label of $P\dagger_n$.

21. *Reduction of* Q_n, which has no summit 555. A Q_n is either an R_n which has edge or edges 55, or an S_n which has no edge 55. And R_n is either R_n which has no edge ϵ just defined, or $R\dagger_n$ *crossed*, which has edges ϵ, being the Q_n of the preceding article.

A *window of n*, or of *n* pentagons, is a range of *n* 5-gons, making $(n-1)$ edges 55 and no summit 555, and it is written

$W=(2^a, 3^b, 4^c \dots)$, showing a windows of two, b of three, &c., upon the solid.

A *circle of n* is a range of n 5-gons making n edges 55 and no summit 555; it is written $C=(6^a, 7^b, 8^c, \dots)$, showing a circles of six, b circles of seven, &c. These notes W and C are entered on the label of every Q_n, and may also be added on that of a P_n or $P\dagger_n$, where complete distinction from other solids requires them.

Every window of two has one marginal edge 55; every one of $n > 2$ has two marginal 55, and $n-3$ other 55.

A circle has no marginal 55. The 5-gons not found in W and C have no edge 55.

22. *Reduction of* $R\dagger_n$. This reduction is simply the deletion of every different edge ε upon $R\dagger_n$, whereby we obtain so many different bases $P\dagger_{n-1}$. After constructing an $R\dagger_n$ on a $P\dagger_{n-1}$ (20), we enter on its label the number E of its edges ε, whether different or not; and under m in m_c we write the number of its different edges ε. When our work is done we shall find ΣE_0 on the $P\dagger_{n-1} = \Sigma c$ on the $R\dagger_n$. By comparing the numbers ΣE_0 and Σc, we shall often discover that our table of the $R\dagger_n$ is completed before we have operated on all the marked 65 of $P\dagger_{n-1}$; (20).

The edges ε on any $R\dagger_n$ are, and are only, first, four ε, making three pairs (14, 24, 31) $\varepsilon\varepsilon$, meeting every marginal 6-gon (A55555) on $R\dagger_n$, which are four different ε, if the 6-gon is not zoned: secondly, one pair $\varepsilon\varepsilon$ meeting, not in the same edge of it, every 6-gon AB5555 $(A > 5, B > 5)$: thirdly, one pair $\varepsilon\varepsilon$ meeting every 6-gonA55B55.

The first $R\dagger_n$ that occur are two $R\dagger_{20}$. One is a six-zoned monarchaxine heterozone, $6^8 5^{12}$, m_1, $E=12$, $C=6^2$, whose three zones are $460^4 0^2$, $84 \cdot 0^4$, 60^6; and whose base is $P\dagger_{19}$, $6^7 5^{12}$, monozone, m_1, $(1_8, 3_5)$, $Z=650^3 0^3$. The other is a triaxine homozone $6^8 5^{12}$, m_2, $E=12$, $C=12$, $Z=260^5 0$; whose bases are two $P\dagger_{19}$, both 2-ple monaxine heteroids, with frames $(2_4 2_4)$, and $(1_3, 1_3)$, and both marked m_1 and $E_0 = 1$.

It is not *necessary* to enter the numbers W and C on the label of $R\dagger_n$.

23. *Reduction of* R_n which has no edge ε. If R_n has a window or windows, it is reduced by effacing a marginal 55 of a least window (21). Every different such 55 gives a different base. If R_n has no windows, it must have a circle or circles; and the reduction is effected by effacing any 55 of a least circle. Every different such 55 gives a different base. If R_n has both windows and circles, we reduce as above at a least window, whether it has or has not more pentagons than a least circle. The base is always $R\dagger_{n-1}$, or R_{n-1}, or S_{n-1}.

The number c of bases of R_n is that of the different marginal 55 in all its different least windows, if it has a window; or if it has none, c is the number of the different 55 in all its different least circles. And this c will have been written in m_0 on the label of R_n, as soon as it was formed.

The first R_n is R_{22}, $6^{10}5^{12}$ 5-zoned monarchaxine homozone, m_1, $C = 10$, $46^{11}0^4 0^2$, of which the base is $R\dagger_{21}$, $6^9 5^{12}$, 2-ple monaxine heteroid, m_4 $W = 12$, $E = 8$.

The next is R_{24}, $6^{12}5^{12}$, 3-ple monarchaxine, m_1, $W = 4^3$; whose base is $R\dagger_{23}$, $6^{11}5^{12}$, asymmetrical, m_4, $W = 5,7$; $E = 4$.

24. R_n is constructed on $R\dagger_{n-1}$, on R_{n-1} or on S_{n-1}. R_n is formed on $R\dagger_{n-1}$ by drawing on the latter a bisector 55 of a 6-gon, so that, first, no pair of edges $\varepsilon\,\varepsilon$ on $R\dagger_{n-1}$ shall remain; secondly, no summit 555 shall be introduced; and thirdly, so that the drawn bisector shall be a marginal 55 in a least window of R_n, or, if there is no window, shall be a 55 in a least circle of it. If no such bisector 55 can be drawn on $R\dagger_{n-1}$, which frequently happens, and is readily seen, no construction is possible on $R\dagger_{n-1}$, except by imposing a movable frame.

In order that no pair of edges $\epsilon\ \epsilon$ shall remain on $R\dagger_{n-1}$ (first condition above), it is necessary and sufficient that either two 5-gons or one 5-gon, met and augmented by the bisector 55, shall have for side one ϵ out of every pair of edges $\epsilon\ \epsilon$ on $R\dagger_{n-1}$.

R_n is constructed on R_{n-1} by drawing any bisector of a 6-gon of the latter which introduces no 555, and which shall be a marginal 55 in a least window of R_n, or if there is no window, shall be a 55 in a least circle of R_n. Hence if R_{n-1} has a window of two, no line can be drawn to be a marginal 55 in a window of three, unless the operation destroys that window of two. The bisector meeting *a* and *d* in the 6-gon *a*BC*d*EF, the capitals being not 5-gons, makes a window of two whatever be *a* and *d*. If on R_{n-1} no bisector above described of a 6-gon can be drawn, no construction by a line is possible on the solid, unless an edge A5 can make it S_n by destroying all edges 55.

25. *Reduction of* S_n, which has no edge 55. There is no limit to the number of the S_n, but *n* rises rapidly. The simplest is S_{42}, the solid of Urania in Question 7120 of the *Educational Times*, July 1, 1882. The next is S_{77}.

On every S_n is a 6-gon 6_a having opposite summits $6_a6_b5_c$ and $6_a6_d5_e$. Because S_n has no 55, 6_b5_c can be effaced without introducing a 4-gon, whereby 6_a becomes 5_a and $6_a6_d5_e$ becomes $6_d5_a5_e$. The base is R_{n-1} which has more edges 55 than one, that disappear when 6_b5_c is restored.

I will not undertake to prove that there is no S_n without a 6-gonal face. I see my way to none such.

26. The rules for construction (15, 16, 18, &c.) are the converse of those for reduction. The student can easily write them out formally. $R\dagger_n$ is constructed only on $P\dagger_{n-1}$ (20). R_n is constructed generally on $R\dagger_{n-1}$, and is the only solid of which $R\dagger_{n-1}$ is a base, except P_{n+e}, which can be completed by the imposition of a least movable frame on any base. On

R_{n-1} S_n will of course be constructed, if we push our processes far enough; but the few S_n for $n < 500$ can be more directly and expeditiously formed.

If the reader who may care for these things is content to form of the solids Π_{24} only those whose highest faces are 8-gons, and the number of whose different 5-gons is the solution of the difficulty of the unhappy Vizier of Borneo (See Q. 7081, *Educational Times*, January, 1882), I think, but I will not guarantee it, that he will not need to expend *ab initio* much over a quire of foolscap. It is useful to shade the 6-gons, and to write 7, 8, &c., on higher faces. I know that among the more than fourscore $6^{12}5^{12}$, which have twelve 6-gons, and the construction of which includes solutions of the problems of Apollo and Minerva (see Q. 7096, June, 1882, *Educational Times*), nearly three-fourths are only once made, and about half a dozen are more than three times made.

27. The main difficulty lies in the symmetries of the solids, on which depends the number of different operations possible in reduction or construction. It requires a practised eye to detect the symmetry or unsymmetry of Π_{n+1} or Π_{n+}, formed by addition of an edge or a frame to Π_n, in whatever posture or distortion the new figure is presented. A 24-edron may be twice drawn so that the identification of the two figures shall not be quite easy.

On this matter I can offer no further help here. Nor can I refer the student to any other page extant in this youthful planet, which contains, beyond a few hints of mine in these *Proceedings* and in those of the Royal Society, a scrap of information on this topic of Polyedral Symmetry, except to No. XXV. in Vol. 152 of the *Philosophical Transactions*, 1862. He will find there, not what might be there, but more than is required to enable him to masticate, what the preceding brew will help him to digest, this morsel of a question chipped off by Professor Cayley from the then well-explored mountain of the Polyedra. So far as I know, that first chapter of my complete theory is unread. The reason may be that there is not more to read. Whose fault is that? Not mine.

28. If I have not the pleasure of learning that I have at last found a reader of the moderate enterprise above demanded, I can easily give in a future paper the rules of construction in formal and full detail, with figured examples of their application, together with at least summary solutions, if they are wanting, of some rhymed questions on these Polyedra which have appeared in the *Educational Times*.

CORRIGENDA.

Art. 10, line 5; *for* "every" *read* "every such."

Art. 16; *dele* all from "Bisecting" *to* "in (13);" and *substitute* "Cutting on P'_{20} 6_1 from 7_1, we obtain P'_{21}, m_1, asymmetric, $87^2 6^2 5^{16}$, $7_2 7_1 8_2 6_1 = i8_8$, $6_0 6_8 7_0 7_2 8_2 = i7_8$. Bisecting 6_1 in P'_{21}" . . . .

Art. 18; *dele* (lines 14, 15) "of five or six walls."

Art. 19; *for* "(2 R + 2)-gon" *read* "(2 R + 2)-edron."

Art. 20, line 23, *dele* "edges not having a summit 655."

Art. 21; *for* "W = &c.," *read* "in W = &c."; and *for* "C = &c." *read* "in C = &c."

Art. 23; *for* "$46^{11}0^4\mathbf{0}^2$" *read* "$460^4\mathbf{0}^2$."

It may be gathered from Arts. 17 and 18, and it should have been more clearly laid down, that no movable least frame is ever to be completed by an edge; for such frame must always be imposed; and that no immovable least frame which has a zero edge in its contour is ever to be completed except by drawing a zero edge of it.

It is possible that fewer repetitions of the same solid would occur in construction, if for *least frame*, which occurs frequently in the rules for reduction and construction, *greatest frame* were substituted in those rules. But I am by no means satisfied that such gain would follow from the change.

T. P. K.

was Tetrarch of Trachonitis, and had [illegible] digest, this morsel of a question chipped off by Professor Cayley from the then well-explored mountain of the

FLAVIUS JOSEPHUS.

By Rev. Dr. W. STERN, Ph.D.

After the death of the Emperor Tiberius, a brute in the shape of man, who had divided his time between perpetrating deeds of the most cruel and atrocious kind and the most unnatural voluptuousness, Caius Caligula became Roman Imperator. The Senate and the people had joyfully recognised the son of the noble Germanicus, and the Prætorians had proclaimed him with jubilation. They thought him to be designated to revive the hopes that had vanished at the death of his father. But these hopes were far from being realised; Rome and the Roman world were bitterly disappointed. Caligula was an unparalleled monster in whom all the vices, even contradicting ones, were combined; and it was only doubtful which of those vices, whether cruelty, or baseness, or folly, was the predominant one. He seemed only to reign to show the world—as Johannes von Müller says—"what people allow to be done with them." His morals were corrupt, his passions indomitable, his vanity was akin to folly, his government tyrannical, and his whole character an awful one. After the time of Herod, the assassin of the Maccabean family, Palestine became a sport of the Roman Emperors, and shared the moving interests of the time with the rest of the Roman empire.

The oppressive yoke of the Roman Governors lay heavily upon the people. Judæa, Samaria, and Idumea had become Roman provinces. Herod Agrippa, grandson of the great Herod, who was always a friend of the party that was victorious at the time being during the Roman civil war, was Tetrarch of Trachonitis, and had expelled Herod

Antipas, his father's brother, from Peræa and Galilee. The latter, disgraced by the Emperor, died in a foreign country, dishonoured and friendless. Petronius came to Judæa with an army, in order to erect in Jerusalem the statue of the foolish Caligula, for the sake of its being worshipped. The Jews assembled, with their wives and children, in the plain of Ptolomais, and followed Petronius to Tiberias, entreating him to respect their custom and religious feelings, declaring that they would die rather than violate their sacred laws. At such a time, in the first year of the reign of Caius Caligula (37 C.E.), Josephus first saw the light. He was one of the most prominent and brilliant personages in the annals of Jewish history, a man who, with regard to his character and deeds, his learning, his importance and worthiness, is not sufficiently known nor duly appreciated by his own people. He was formerly mistaken for Josephon ben Goryon, but since Jewish history has been diligently and thoroughly studied, it is well known that the latter, himself almost a stranger in the history of his people, wrote fables instead of history. Nevertheless, Josephus' name is seldom heard among his own people.

Joseph ben Matthia, commonly called Flavius Josephus, was descended, on his father's side, from a priestly family, and on that of his mother from a royal one. There is no doubt as to his pedigree, because, at the time of the second temple, the genealogies were carefully kept by the high priests, and they authenticated the fact that his ancestors belonged to the first division among the twenty-four orders of the priesthood who, by a regulation of King David, alternately conducted public worship during a whole week. His father, priest Matthias, was a reputable and virtuous man, held in general love and esteem at Jerusalem; his mother was the grand-daughter of the first high priest of the Royal family of the Hasmonees or Maccabees. Having been carefully reared and educated, together with his brother Matthias, in Jerusalem, he excelled, by his mental gifts, at the early age of fourteen, and at this tender age, during the convocations of the high priests and the leaders of the city, gained general praise and applause on account of his profound knowledge of the law. At the time of Josephus there existed among the Jewish nation three sects, differing from one another in theological, philosophical and political respects, the Zaddućees, Pharisees, and Essenes.

Josephus, before selecting one or the other of those sects, wished first to examine their tenets, and then keep the best; he wanted to know their views, doctrines and maxims by his own experience and conviction. Like Joseph in the Bible, Josephus was seventeen years old when he commenced to examine the speeches and actions of his brethren. The sect of the Essees, or Essenes, made the greatest impression upon, and was the most interesting to, him, because of their strict mode of living and their stoical virtues. He became the disciple of a certain Banus, who dwelt in a desolate and uninhabited region, was clothed with the inner bark of a tree, lived on the fruits of the field, and bathed, according to the custom of the Essees, daily in cold water. With this Banus, Josephus lived for three years. He remained with the enthusiast, whose abstinence and blameless life excited his esteem and admiration (*Vita, Ant.* xvi., 7, 1), till at last he began to consider that such an ascetic and anchoritical life neutralised every active power, and that the highest virtue of an hermit who does not contribute anything towards the social or moral welfare of the human race, cannot be called virtue in the proper sense of the word; for God Himself said, "It is not good for man to be alone," without society. He therefore returned to Jerusalem. There, in the metropolis, he devoted his attention to state affairs and public duties, and adopted the doctrines and life of the Pharisees. His thirst for knowledge prompted him to acquire the Greek language and Greek culture. He blamed his co-religionists for neglecting Greek literature and cherishing only the study of their own laws and the interpretation of Scripture. Although with great efforts he learned Greek, he could not, even after several years' hard work, attain the proper accent. Nor could he ever completely master the language, but had to be assisted by competent teachers in the writing of his Greek works. He was astonished that, in his time, when one would suppose that, through the Herodians, the Greek language would be as much in use as in Syria, scarcely two or three Jews could understand Greek.

Soon Josephus had an opportunity in Jerusalem to prove his energy. The Roman governor had some of his (Josephus') friends, who were priests and honest men, put in prison for a trifling cause, and afterwards sent to Rome. Josephus heard of it, and was animated by the desire to effect their release, the more so as he had heard of their religiousness and their unshaken fidelity to the ancestral faith, and that in their captivity they lived on figs and nuts, and steadfastly refused every forbidden food. He undertook a journey to Rome when only twenty-one years of age. His life was greatly imperilled at sea. The waves of the Adriatic sea had washed over the vessel, and threatened it with destruction during a very boisterous night; and it was only with great difficulty that out of six hundred passengers, eighty could be saved, having been taken on board a passing Cyrenean ship at the break of day. He arrived safely at Puteoli (Puzeoli), and made friendship with a mimic actor, named Alkiturus, who, being a Jew by birth, and a favourite of Nero, introduced Josephus to Popæa, the Empress, at whose solicitation his imprisoned countrymen were set at liberty. He then returned to Palestine, having received costly presents from the Empress. There, however, every one was filled with anger against the Romans. That fatal and famous war began which was to dash to pieces the Jewish Cmmonwealth, to make an end of the independence of the Jewish nation, and to bring unspeakable and immeasurable misfortune over Palestine. The principal cause of that calamitous event was the baseness of the Roman governors, who, in cruelty, vied with their Emperors; for although the Jews had borne with ill-will the yoke of the Romans, the Roman governors could have extinguished the fire of rebellion in its infancy, instead of which they kindled, by their cruel scornfulness, the blazing flames of revolt, by which at last the temple was laid in ashes and the country became desolate.

Gessius Florus, the governor of the province at that time, drove the people to despair by his partiality, covetousness, chicanery and thirst for blood. True, the governor of Syria, Cestius Gallus, was his superior, but Florus ruled with such terrorism, that nobody ventured to complain of him.

The inhabitants of Jerusalem became divided into a revolutionary and a peaceful party, and a civil war arose, which I may pass over in silence, presuming that it is well known to all of us.

On the Passover feast (66 C.E.), Cestius Gallus came to Jerusalem. The people seized the opportunity of laying before him their complaint of Florus, but the latter became, on that account, all the more infuriated and revengeful. Every prospect of relief was lost to the Jews. Nero was a mad and dissolute fellow, Agrippa (the Jewish King) was a servile creature of his, and the desperate people found no other refuge but in self-help. In Cæsarea there were conflicts between Jews and Syrians, the latter having been enticed by religious hatred and racial enmity. The Cæsareans desecrated the synagogue of the Jews, who defended themselves, and gave Florus a large sum of money in order to win him over to their cause; but he did not protect them. In order to reduce the people to extremity, he demanded of the wardens of the temple seventeen talents of silver (=£4800) out of the temple-treasure, in the interest of the Emperor. On being ridiculed for this by the people, he passed a severe judgment upon, and massacred many of them. The people humbled themselves, and, adjured by the high priest, went to meet the entering Roman troops, who, however, behaved themselves in a hostile and insolent manner. But when Florus went so far as to declare that he would confiscate the funds of the temple, the people ran up to the temple-mount, threw stones at the soldiers, and thus checked their advance. Thus the open revolt had begun. The intimidated Florus went off, and the inhabitants of Jerusalem became divided into a *revolutionary* and a *peaceful* party. The former was headed by Eleazar ben Anania, a man of noble high-priestly family. At the head of the latter there were the wealthy and prudent, who dreaded the gigantic power of Rome, together with King Agrippa and his relations, the Herodians, Kostobar, Saul, Antipas, and the priests Ananias and Ezekias. They besought Cestius to investigate the misdeeds of the governor, Florus, and satisfy himself of the loyal feelings of the people. Cestius sent a commissioner, named Neapolitanus, but the zealots knew how to dispose the people to, and keep them in, revolt. Agrippa's masterly speech, delivered by himself on the platform of a colonnade not far from the temple, would certainly not have failed to make an impression on the people and turn their hearts again to the Romans, had he not gone too far. He wanted to persuade the people to subject themselves to Florus until his successor was appointed. But they became so embittered that they threw stones at Agrippa, and forced him to quit Jerusalem. Josephus was among the number of those who tried to assuage the wrath of the people ; he asked them to consider what nation it was they were going to fight with, and how much they were inferior to the Romans in experience, as well as in power of war, and that they should not in so thoughtless a manner plunge into ruin and adversity their country, their families, and themselves. But Josephus' warnings likewise remained unheeded. At the suggestion of the captain of the temple guard, the bold youth, Eleazar, son of Ananias, the officiating priest declined to accept the offerings made by the heathens, and even those of the Emperor. In vain the most respected of the Pharisees attempted to make them aware of the danger of such a step, and in their despair of the possibility of bringing the revolutionary party to their senses, they asked Florus and Agrippa for assistance—truly a perilous and fatal expedient! Now the signal was given for civil war. Agrippa sent 3,000 horsemen, consisting of Auranites, Trachonites, and Batanæans. With these the peace party occupied the upper portion of the city, whilst the opposite party took possession of the lower part and the temple. An affray ensued between the two parties, in which the royal troops were defeated. The rebels now marched into the upper city, burned the palaces and the archives containing the bonds, in order to enlist the debtors also in their favour, and took the Antonia castle by storm. Moreover, a certain Menahemus went to Masada, broke the arsenal open, armed his companions, and entered Jerusalem, where he caused the soldiers that were enclosed in the royal palace to be killed, and the high priest, Ananias, to be massacred, and where he ruled with an absolute power. The people, however, stimulated by the jealousy of Eleazar, did not suffer that despotism to be lasting. Menahem was assaulted in the temple, his assistants were massacred, and he himself was seized in his flight, and, after severe tortures and sufferings, was put to death.

Now the people hoped to make an end to the revolt, and re-establish order; but Eleazar, with his followers, thought differently. The annihilation of the shut-in Roman soldiers, under their leader, Metilius, was his object; and when the latter, unable to defend themselves, surrendered, and, according to a treaty, laid down their arms, Eleazar's band fell upon them, and, in assassinating them, called down upon them the curse of God and the abhorrence of the whole city. Florus was at that time in Cæsaræa, where he stirred up the ferocious racial battle, Jews and heathens murdered each other in Judæa and Syria, and in the city corpses lay heaped up, which remained unburied. In the Syrian capital a converted Jew, named Antiochos, by means of abominable lies, incited the people against the Jews, who were plundered and massacred. The hostilities which had broken out in Cæsaræa, between Jews and heathens, extended to Alexandria. There the apostate nephew of the philosopher Philo, the governor, Tiberius Alexander, fostered the corrupting civil war.

At last Cestius saw the necessity of going to Jerusalem. On his way there the towns that were void of inhabitants were set on fire; for all were assembled at Jerusalem to celebrate the Feast of Tabernacles. Thus the scourge of war surprised the people, who met together and were united at public service.

In a state of rage, the multitude, seduced by the revolutionary party, ran to the battle and broke through the Roman battle array; and it was only after several days that the Procurator succeeded in throwing them back and occupying the outward parts of the city. Though the rebels fought with renewed violence, keeping the Romans in check for five days, Cestius, favoured by the greatest part of the people, who would have received him with enthusiasm, would have become master of the temple, had he not suddenly given orders to sound the retreat, and left the city, in spite of the people's feeling and the bravery of his troops. That scandalous flight very nearly brought ruin on his army. Like a herd of tigers, the Jews fell upon the retreating Romans, inflicting upon them a loss of nearly six thousand men, and certainly would have routed them thoroughly, had not the latter, by a stratagem, gained a considerable advantage over them. The retreat of the Romans inspired all with fresh courage; even the men of peace were now carried away by the general current. God Himself seemed to fight for the courageous, and he who still sided with the Romans was declared to be a traitor to his country. At a meeting which took place in the temple, the requisite warlike measures were taken. Jerusalem and the single counties received generals, who carried on the preparations for the war, and had to unite the people for one and the same object.

Josephus, accompanied by two worthy priests, Joazar and Judas, was sent to Galilee to take the command of that important province, which was likely to be the first that would be invaded again by the Romans.

On his arrival there it was his first care to secure for himself the favour and affection of the inhabitants. He selected seventy of the most intelligent and experienced of the people to share with him the government of the whole of Galilee; seven justices of the peace were appointed in every city to decide in petty strifes; important matters and capital offences, however, he ordered to be brought before him and the seventy. He then fortified the fit and proper places with walls, as Jotopat, Beerseba, &c., entrenched the dens on the Genezareth, and the rocks in Upper Galilee, erected works of fortification around Gamala, Seleucia and Logane, permitted the inhabitants of Sepphoris to build a wall at their own expense, as was really done by a certain John, son of

Levy, round Gishala, and finally equipped an army of 100,000 young men. That army he organised after the Roman system, subordinating the single divisions to dekurions, captains, colonels, and generals, who stood at the head of numerous corps. He also taught them the giving of signals to one another, the sounding of the trumpets to call them to the battle and recall them; further, how the wings had to make the attacks, the different movements and evolutions; how they had, when the case arose, to render assistance to their endangered and fainting fellow-soldiers; and, lastly, impressed upon them everything that was requisite to keep up presence of the mind and perseverance of the body to meet the hardships of war. Besides which, he reminded them on every occasion of the discipline of the Romans, and of the fact that they would have to contend against men who, by their physical power, had conquered nearly the whole world. He would take, as a sufficient proof of their discipline, if, before facing the enemy, they would abstain from every iniquitous deed. For, he said, wars could only be carried on successfully if the warriors enjoyed a good conscience. Bad-minded and wrongly-disposed people had not only the approaching foe, but also God, against them.

The rebellion reached its climax in Galilee. In Tiberias, Justus ben Pistos and Joshua ben Saphia were the life and soul of the infuriated revolutionary party, which put down the peace party, and was enraged against the Romishly-disposed city of Sepphoris. That Josephus, in his capacity as governor of Galilee, with whom the whole burden of responsibility rested, played an ambiguous part, is attributable to the fact that he was perfectly convinced of the futility of waging war against the all-powerful Romans. Galilee was divided into two camps—John of Gishala, the sworn enemy of Josephus, on one side, and Josephus, with his party, on the other. The latter was impeached for want of decision, by John, at the Synhedrion, in Jerusalem, and an enquiry was made. But the commissioners of the Synhedrion were often in great danger of being maltreated, and even torn to pieces, by the partizans of Josephus, had not the latter warded off the storm. On the other hand, Josephus' administration was highly eulogised by his adherents. In the Synagogue of Tiberias his adversaries wanted to lay hold of him, but the people saved his life. Josephus was rehabilitated by the Synhedrion; yet bloodshed could not be prevented from being committed by one brother against another. Tiberias, weary of the strife, submitted to King Agrippa. Sepphoris demanded a Roman garrison, against which Josephus fought with misfortune. Meanwhile, Vespasian, recalled by Nero from Brittany, arrived to suppress with his vigorous arm the rebellion in Galilee, and carried his object by a skilful strategy. Gabara was soon taken; Jotapata, which offered a stubborn resistance, was taken by the treason of a renegade. A few days previously Jaffa, wanting to operate in the rear of the Romans, had succumbed. Josephus conducted the resistance of Jotapata, but when that fortress was taken by surprise, he hid himself in a cistern connected with a cave, where he met forty warriors who had found the same refuge. Being attacked and overpowered by the Romans, they determined to die one by the hand of the other. Josephus remained last with a companion, disarmed him by persuasion, and surrendered to the Romans.

Vespasian treated him with kindness, and even with distinction—a fact which Josephus ascribed to the circumstance of his having foretold Vespasian that he (Vespasian) would become Nero's successor. Now came the turn of the seaports, Joppa and Tiberias, both of which surrendered without striking a blow. A year after the rebellion at Jerusalem, the greatest part of Galilee was subdued. In vain they fought desperately in Gamala; in vain Gishala endeavoured to hold out under John: they had to surrender, their walls being razed. The fate of Jerusalem is too well known. Josephus accompanied Titus in his triumphal procession to Rome. Vespasian presented him with extensive estates in Judæa, allowed him an annual stipend, ceded him an apartment in his private palace in Rome to live in, and made him a Roman citizen. He assumed the name of the Flavianic imperial dynasty, and called himself Flavius Josephus. In Rome he described the Jewish war in the Hebrew tongue, in seven books. Titus himself perused those memoirs. A certain Justus of Tiberias charged Josephus with partiality, and wrote against him a history from Moses to the last king, Agrippa, in which he endeavoured to slander Josephus as being an enemy of Rome, and to deny his descent from the Hasmonean family. This gave rise to an exasperating controversy. Afterward, Josephus engaged in writing a comprehensive work on Jewish history, from the beginning of the world to the time of Nero, at the suggestion of his friend Esaphroditos, a man liberated by Nero and favoured by Domitian. That work was accomplished by Josephus in 94, under the title of *Antiquities*. Josephus also wrote an autobiography, and described his conduct in conducting the war. His fourth and last work is a reply to Apion (*contra* Apionem) and other Jew-haters, who defamed Judaism and the Jewish nation, denying their antiquity. The authorship of the fourth book of the Maccabees was erroneously imputed to him.

We now come to the second part of our subject, treating of the significance of Josephus as an historian, and the sympathies and antipathies by which he appears to have been influenced.

II.

If we desire to give our opinion on the significance of an historian; if he is to deserve the name of a *worthy* historian; and if his name is to be as immortal as the heroes and their deeds, which he transmits to posterity, then the qualities of his heart, as well as those of his mind, must be brought before the forum of historical criticism, in order to form a precise judgment. The historiograph must have closely examined and sifted the gathered and ordered material, and minutely investigated the hidden causes and secret motives of the events he describes. He must isolate himself, and place himself upon a higher standpoint, in order to review from thence the actions of men, their characters, circumstances, and interests, in an impartial manner; and, unbiassed by prejudice, he must look at the events in their true light. He must have the courage, freely and publicly, to record the truth, by which he himself must be permeated, even at the risk of drawing upon himself the anger of the powerful and the hatred of the populace, or of being deprived of the comforts of life and subjected to reproach and persecution.

Now, has Josephus, as an historian, done justice to the requirements of an ardent and conscientious love of truth, without which history loses its dignity and true character? Has not he defiled his pen with falsehood and flattery? Were not the conditions of his time such, that truth was proscribed, and its utterance would have been a useless self-sacrifice?

This criticism Josephus has to meet, equally with Thucydides, Tacitus, Gibbon, Macaulay and Johannes von Müller, &c.; and if his candour and truthfulness are beyond question, then only it may be clearly admitted that he had the power of speech at his command, that his expression was lucid and of intrinsic worth; and then only his fame will be accomplished, and even the nation will be glorified that produced a Josephus. Vivacity of description, vigour of language, and a dramatic conception were features of his, as well as of all the historians of antiquity who were so near the scenes and times which they depicted.

Besides which, Josephus was an eye-witness to, and an active participator in, the events of his time. His representation is genial and masterly, ingenious and tasteful, flowery and ornamental. Hieronymus calls him the Greek Titus Livius. Of the latter it was said, as of Cicero: "His genius was as great as the empire of which he wrote." Others call Josephus the Polybius of his nation. His classical style, extensive reading, and searching mind, fully justify that attribute. But literary composition is not the essential requisite of an historian. The historical critic asks above all whether the facts be truthfully rendered, or what heterogenous motives guided his pen.

Now, what were the sources from which Josephus drew information? Up to the outbreak of the war which destroyed the Jewish Commonwealth, and in which Josephus took an active part, that is to say, up to the time of Simon the Maccabee, it was in the first place Holy Scripture of which Josephus made use. The piety and reverence with which he treated that authority is clearly seen from his own statement, the sincerity of which cannot be mistaken. "We Jews," he says (*contra Ap.* i. 8), "have not numerous books which contradict one another; there are but twenty-two comprising the history of past times, and which are justly considered to be truthful and authentic. Five of these books, containing the origin of the world and certain laws, and concluding with the death of Moses, come from the latter. They thus embrace in themselves a period not much short of three thousand years. From the death of Moses to

Artaxerxes, who reigned after Xerxes, the prophets wrote, in thirteen books, the history and events of their times; the remaining four books contain hymns of praise to God and practical philosophy for man. From Artaxerxes down to our present age, everything has indeed been recorded; but these writings lack authenticity, as the exact succession of the prophets was uncertain and doubtful. The good faith we have in our sacred writings is clearly proved by our demeanour; for despite the long time which has elapsed already since their existence, yet nobody has ventured either to add to or shorten anything from them, since it is innate with the Jews to revere these books as divine instructions, and steadfastly keep to them, and, if needs be, even to sacrifice their lives for the sake of them."

The deviations made by Josephus from our biblical text are, indeed, not few, but as they mostly concern modes of reading, not, however, the facts themselves, it is certain that Josephus had before him a Bible copy of a different edition. If Josephus, for instance, causes the butler of Pharaoh to relate his dream to Joseph as follows:—"And I saw in my dream a branch with three sprigs . . . and I pressed the grapes out into the *cup which the king held in his hand*" (*Ant.* ii. 5), whereas, according to Scripture, the butler had the cup in *his own hand;* or if Josephus tells us that Joseph, in Egypt, was authorised by the king to clothe himself in purple, and to wear a seal-ring on his finger, whilst it is said in the Bible, the king took his signet from his finger; or if Josephus has it that Raguël, or Jethro, on hearing of the well-being of his son-in-law, joyfully betook himself on the journey, in order to greet Moses, Zipporah, and their children (*Ant.* iii. 3), whereas we read in Scripture that he brought his daughter Zipporah and her two sons with him from home; or, further, if Josephus reports (*Ant.* iii. 9), that when Nadab and Abihu, the two sons of Aaron, had been consumed with fire, Moses ordered their father and brothers to take the corpses outside into the camp, whilst we are told in the original text (Lev. x. 4), Moses called unto Mishael and Elizaphan, the sons of Uzziel, uncle of Aaron, "Come near, and take your brethren away," &c.—there is no reason at all for alleging that Josephus had not drawn from the original source, but from the source of a second hand, or that he forged the holy sources; on the contrary, Josephus excuses himself with having before him an incorrect biblical copy; the deviations and alterations were not made by him arbitrarily, but they were owing to the different ways of reading and additions which he found in the copy received from Titus.

In the memoir of Demetrius to Ptolomais Lagi, mentioned by Josephus (*Ant.* xii. 2, § 4), it is said as follows:—"Acting upon this command with the greatest care, I hereby give notice that among others we are still wanting in the codes of the Jews; they being written in Hebrew, which we cannot understand. There are, indeed, copies of them which, however, are incorrect, because royal care was not taken with them." Such a faulty copy was certainly that taken by Titus and handed to Josephus. The latter, moreover, used *tradition* as an authority—tradition in its higher and wider sense, comprising all the ways and means by which previous generations influence the later ones, and tradition in its usual sense, viz., a legend or story, which is transmitted verbally from one generation to another. Tradition, says Rotteck, a German historian, is the most primitive, and also a very precious, historical source; for the original history of most peoples is based upon such legends and narratives which, indeed, were written down, but later on did not alter their nature, and must likewise be judged as such. Josephus has, as an orthodox Jew and a Pharisee, considered the traditions which in the Rabbinical schools were taught to go hand-in-hand with Scriptural history, to be even as sacred as the Bible itself, and the sources of such treasures can still be proved in the Talmud and other Rabbinical writings. One needs only compare the whole story of Moses, as told by Josephus, with narratives in the Talmud and the Jewish Chronicles, in order to be convinced of the truth of this statement. The cases in which Josephus lays himself open to fabulous adornment—as, for instance, that Rëuben upbraided his brethren for having brought deep affliction on the mother by depriving her of her son Joseph in an unnatural way, although Rachel was dead long before—are extremely rare. With reference to later periods, when the biblical books failed him, Josephus has made use of numerous home and foreign authors. Among the many writers referred to by him, I will only allude to Aristoteles, Anaxagoras, *Cæsar's Commentaries*, *Drakon's Law*, Herodotus Halicarnasseus, Herodes, Homer's *Poeta*, Titus Livius, Lysimachus, Manethon, Menander, the translator into Greek of the Sydonian Chronicle of the Phœnicians, Philo the Elder, Plato, Polybius Megalapolitanus, Pythagoras, Socrates, Thales, Thucydides, Timogenes, and Zeno Zophrion. Besides these, he must have had a great many more at his disposal, since many Hellenic Jews, within and without Judea, especially those in Alexandria, treated upon single parts of the post-biblical history of the Jews, of the records of which several have been preserved among the apocryphal books of the Old Testament.

Josephus did not blindly use the above-mentioned writings without closely examining their statements, for we not infrequently find them altered. Thus, for instance, Josephus' description of the certainly obstinate Aristobul, in *Ant.* xx., 10, is contrary to that of Timogenes, who depicts him as a modest and high-minded man.

Antiochus of Sidetes had not done nearly so great damage to Jerusalem as is related by Diodor of Sicily; it is reduced to the right measure by Josephus. The statements of Tacitus are often rectified by Josephus, who is decidedly more trustworthy, so far as the internal affairs of the Jews are concerned. At the same time, Josephus cannot be exonerated from having taken up in his history many legends that had been in circulation during the Maccabean period. Thus his whole representation of the history of Antigonus, Aristobul, and Alexander Yannai is of a legendary character. He also seems to have contradicted himself, his historical statements in the *Antiquities* being often at variance with those in the *Wars*. But this can only be to his credit, as he took great care to correct previously made errors in his later book of history. Where one and the same fact is differently related in the *Antiquities* from what it is in the *Wars*, the former has the preference. Even in the *Antiquities*, he occasionally corrects himself. For instance, in *Ant.* xii., he erroneously describes Juda Maccabeus as a high priest, whilst in *Ant.* xx. 10, 3, as a correction of his mistake, he does not number him among the high priests. The history of the Maccabees, he drew from the *Books of the Maccabees,* as far as their information reached, without, however, always following them in every instance. (Compare the respective passage on the death of the sons of Simon with *Ant.* xiii. 8, 1.)

Let us now hear from Josephus' own mouth the motives that induced him to write his historical books and hand them down to posterity. In the preface to his *Wars*, he says as follows:—"A few authors who have not personally witnessed that war, have disfigured their description of it by vain and absurd things. Others, again, who knew of that famous war as eye-witnesses, have related it in a partial spirit, guided by antipathy against the Jews, or by a desire to please the Romans." He therefore had resolved upon describing that war impartially; he already had previously undertaken this work in the Hebrew language, but felt constrained to do the same in Greek as well. He, Josephus, son of Matthias, a Hebrew and priest in Jerusalem, who first fought himself *against* the Romans, but was by circumstances forced to fight in common *with* them, would give the Parthians, Babylonians, Arabs, and all those who dwelled beyond the Euphrates, true enlightenment as to the cause, origin, and end of the war. The Greek authors who degraded the Hebrews, denying to them energy and courage, did not consider that they were thereby debasing the Romans, causing them to gain the victory in an easy way, without any effort or anxiety. He was, however, at the same time, far from being partial to the Jews, for his motto was impartiality, though he could not help sometimes sighing at the calamity of his people. On the other hand, he had learnt how patient and forbearing Titus was with the Jews, and how he was reluctantly compelled to devastate the city.

But he would certainly fulfil his task independently, for a true historian always brought new facts to light. With this apostrophe to the reader, he justified himself; he laid open his personal circumstances, relations, and qualities as an author; he showed that he *knew* the truth and *desired* to tell it; he did not forget anything of which historical criticism takes notice—his descent, station, office, knowledge, capabilities, his personal character, his system, turn of mind, and even his age. In order still more to elucidate the importance of the portrait, he himself wrote his biography. If it be true—and it is almost certain—that a stranger cannot be so historically true as a native, he is certain to forfeit all confidence if he belongs to a hostile nation, thus being marked with the stamp of partiality. Josephus, as a great man, having intercourse with the most influential people, knowing their character and private affairs, and closely observing the objects and passions of the leaders, had little difficulty in knowing the exact course of events and their real motives. He could clearly see the tools and moving powers, since he did not sit as a *savant* in his study, from whence he reviewed the contentions going on in the world, and the hidden play of interests by which they are guided, but he took an active part himself in the negotiations, gave his own vote, and led and commanded himself. Such a man often sees and hears things of which an outsider has no idea.

It is true, he could not be everywhere, the scene of action assigned to him being limited; but he was not such a simpleton as to believe every story told him by any fool or simpleton; he was a man of talent and intelligence, discerning truth from falsehood, and always first considering well before giving his opinion. Has Josephus remained faithful to his programme? He has the misfortune of having aroused suspicion in two opposite directions. In his own time, as I said before, Justus of Tiberias wrote a history from Moses to the last king, Agrippa, in which he endeavoured to asperse Josephus as being a foe of the Romans, and also to deny his pretended descent from the Hasmonean family. (*De Vita* i. 65.) Modern historians, on the other hand, call him a follower of the Romans, an egotist, and a partisan of the imperial dynasty. Now, from the accusations made in his own time, the living historian could clear himself, and to confute them he had a lively controversy, and wrote an autobiography; but the deceased cannot vindicate his honour nor silence his defamers. It is therefore the duty of posterity to couch the spear for him, and take up his cause. Fortunately that task is not difficult, for there is no charge against him that could detract from his honesty and rectitude. A man who wields his pen to save the honour of his people, a priest, Pharisee, and orthodox, who was permeated by the love of his people, could not write a book in the service of hypocrisy and partiality. The fact of his filling a most important post in the war against the Romans, is very much to his credit, showing, as it does, the great confidence which was placed in him. True, his Jewish contemporaries called him a traitor and a coward, but it was the zealots who called him so, when the news was spread that he was in the Roman camp, and was treated by the General with consideration; but nobody thought of denouncing him before that time. Josephus himself speaks of these debasing accusations against him as a man conscious of his innocence. Thus he mentions his going over to the Romans, seeing that it was utterly impossible to prevail against them, and that it was a suicidal war. The only thing that tears from his head the wreath of impartiality is the frequent eulogy he bestows upon Titus, who was declared by the Jews to be a tyrant. But neither those who condemn Titus, nor those who praise him, are right. With regard to the Jews, who curse his memory, an author (1864), describing the Ghetto, in Rome, says, "People will pardon me having made a lengthy description of the history of the Jewish war by Flavius Josephus. I have done so because of its general interest. Everybody will learn therefrom that the Jews had good reason to hate the Imperator Titus. The pompous triumph and the execution of the Jewish General by the Emperor may well be overlooked, having been the law and custom of his time, but the same Titus whose epithet was *Amor et deliciæ generis humani*, had ordered, whilst staying at Cæsarea, the massacre of a great part of the condemned Jews, in honour of the birthday of his brother Domitian. Have, therefore, the Hebrews, no right to curse the memory of Titus? For this reason they also like to evade, if they possibly can, to see the Titus arch on the Forum, in Rome, for its relievos show them the triumphal procession of Titus, and at the side of it is the place where once the Temple of Peace stood, which Vespasian had erected after the Jewish war, and in which he offered the gold vessels of the holy temple." But although it cannot be denied that Josephus sympathised with Titus, yet he must not be branded a partial author, and a man void of good character, less so, as he justifies his respect for Titus in the following words :—" The people of Alexandria and Antioch repeatedly requested the universal ruler, Vespasian, and his son Titus, to deprive the Jews of their civil rights, but they did not succeed. It shows, therefore, how just and generous the Romans were, and especially so Vespasian and Titus. Although they had carried on a very severe and troublesome war with great bitterness against the Jews, the latter not being willing to surrender, and defending themselves to the utmost, yet they would not allow their rights to be affected in the least. They neither yielded to their own anger nor to the petitions of the mighty inhabitants of Alexandria and Antioch. They would not alter their kind behaviour to the Jews, neither out of courtesy to the former, nor of animosity against the latter, for they said, " Those who have taken up arms against us have been sufficiently punished, and as for those who are not guilty, it would be unjust to deprive them of their privileges."

Far more interesting and important, however, are the *Antiquities*, written by Josephus in the leisure time he enjoyed in the reign of Titus and Domitian—a voluminous work on Jewish history from the beginning of the world to the time preceding the war. Let us hear with what intentions he started this work, which adorns him with the palm of immortality, and by what genius his pen was guided. He said he had undertaken it, safely trusting the Gentiles would derive many lessons from it. As once the high priest, Eleazar, had no objection to have the Pentateuch translated into Greek for Ptolemeus Philadelphus, so Josephus did not hesitate to do the same, and even more, in order that the reader may know "that those who walk in the ways of God are happy, whilst those who turn aside from them are unhappy." From the legislation of Moses, Josephus says, the reader also may learn that every legislator must be animated by the fear of God. When Moses wanted to instruct his citizens, it was his intention to refer the law and justice—not to *man*, as other legislators did, but to *God*. Thus it was Josephus' object to show the law of God, given to the Israelites through Moses, in its excellency, in order to encompass Judaism with a beaming crown, and to point out that, although the Jewish Commonwealth had ceased to exist, the *spirit* of the Jewish laws had not lost anything of that excellency. He further wanted to prove that even the Jewish *constitutional* laws had proceeded from the divine Law-giver, having a common origin with the properly religious laws. He would demonstrate that it was only the disobedience of the Jews to those divine laws that brought on their ruin, and that those laws were perfectly worthy of being introduced into the social life of the Roman people. In writing the *Antiquities*, he says, he further wishes to point out the difference that is between *divine* and *human* legislation. The religion of the Romans served the *State* only. If the religion of the Greeks was *poetical*, that of the Romans was cold and *prosaic*. It was not drawn up by poets and priests, but by *statesmen*, who systematically arranged it in dogmas and customs, and made it entirely a *political* machine. In Judaism *religion* was the leader of the State, and God was the legislator. It thus contained dogmas, moral, social and political laws. With these words Josephus defined the mission of Judaism. It was neither worldly dominion nor great warlike deeds which were to make it an authority—its temporal power having disappeared — but the triumph achieved by the divine law was written upon its standard, a triumph which was independent of the *national* Israel and its sanctuary, not having for its theme the world governing dynasties and the most extended national glory and national power.

Josephus ardently loved liberty, but not fanatical liberty. He proved freedom to be the soul and spirit of the Jewish law, and he was most anxious not to see his people enslaved under the Roman sway. He put the religious life of the whole of Judaism in the light of freedom; for a religion of learning and knowledge, he says, cannot surround the minds of its professors with darkness, and cannot demand of them the practice of misunderstood and unintelligible laws and ceremonies. A religion of freedom and self-consciousness cannot serve to degrade man to become a blind follower and a mere machine. Josephus was, as I mentioned before, a Pharisee, and it was the Pharisees (Perushim) who expounded the law in a liberal sense, not being fettered by the letter. They went into the spirit of Mosaism, and endeavoured to bring it into harmony with daily life. They were called Pharisees, a word derived from "parash," to expound and interpret, because they explained the laws and searched after their reasons, in order to go hand-in-hand with the development of Judaism and the religious national life. Josephus was right through a Pharisee; every inch in him was a Pharisee. He was so much permeated by Pharisaism, that he described the Zadducees (a sect so called from their founder, Zaduk ben Bysus, who rejected tradition, and only believed in the written law) worse than they really were, since they never denied, as he said they did, Divine Providence and the immortality of the soul.

Of the Pharisees, Josephus gives the following description:—"Their mode of life is generally simple, far from effeminacy and luxury. They excel in tenacity and consistency in everything they wish to carry out. They attribute everything that happens to the decrees of God, without, however, interfering with the freedom of the will of man, which guides his actions, leading him either to good or evil. They also believed in the immortality of the soul, which will be judged in a world hereafter, and rewarded or punished according to its good or evil deeds, and that the souls of the wicked will have to undergo an everlasting punishment, whilst those of the pious will return into life." (*Ant.* xviii. 1, 3.) "By virtue of this dogma, by the care and attention with which they devoted themselves to the exposition of the law, by the halo of piety with which they knew how to surround themselves, and by the attention they paid to all the political movements, they knew how to win the favour and confidence of the people to such a degree as to exert the greatest influence over the civil and public life, and to become the foremost in the history of the Jewish people." (*Ant.* xiii. 10, 5.)

The dogma of reward and punishment, of divine providence and justice, was not seldom made use of by Josephus in order to restrain the Romans from oppressing the vanquished and subdued Jews. The painful death of Antiochus the Tyrant is related by him as follows:—"When he was kept a long time in his bed, and his pangs and torments were on the increase, he felt his approaching end, and summoned his friends; telling them of the danger of his illness, and declaring that all that had come upon him was because he chastized the Jews so terribly, robbed the temple, and blasphemed God. With this confession he breathed his last. I therefore wonder how Polybius the Megalopolitan, otherwise a truth-loving man, could maintain that Antiochus had so painful an end because he *wanted* to despoil the temple of Diana whilst in Persia. The *will* without the *deed* would not have deserved so severe a punishment; and although Polybius earnestly thinks Antiochus had to die for the reason given by him, it is more probable that he lost his life on account of the *actual* spoliation of the temple in Jerusalem perpetrated by him." (*Ant.* xii. 9, 1.)

Thus Josephus will remain the noble, truthful, and immortal historian, an ornament to the Jewish nation, whose champion he was, a brightly shining star on the firmament of literature, though he is said to have been possessed of certain superstitions, believing in mystical forebodings and witchcraft.

It now remains for me to refer to the last work of Josephus which he wrote against Apion. Whilst the Romans subdued the Jews physically, the Greek authors applied themselves to annihilate them morally. In the first place, the enemies of the Jews denied their antiquity, looking upon them as a new nation. There are, unfortunately, some modern "Apions," who call the Jews, "European Asiates." In the second place, the same Apion decried the doctrines of Judaism, and placed that libel into the hands of Caligula.

Josephus, however, wrote his *Apology* of Judaism, combating the Greeks with the weapons of truth and irony, like a true "knight, without fear and blame," with the most ardent attachment to his faith and his unfortunate people. As some of these charges are, strange to say, echoed now-a-days, I may be permitted briefly to sketch the most important points of the *Apology*.

In the first book, Josephus subjected the Greek historians, who denied the Jews every antiquity, to a severe criticism. He gainsayed their authority, because they contradicted one another, and recorded only by verbal traditions, thus ignoring the accurate truth, and not even *willing* to utter it, whilst the Jews took the utmost care of their records, which they entrusted to the high priests and prophets. That care was persevered in down to his (Josephus') time.

On this occasion he accuses the Greek writers on the Jewish wars. "They published," he said, "some carelessly-written accounts of our latest war. They have never been on the scene of war themselves, nor did they enquire the facts of the acting persons, but compiled something from hearsay, and, shamelessly enough, *boasted of the name of historiographs!*" "The Jews," he goes on to say, "did not come into contact with others, since they neither inhabited a district situated on the sea-shore, nor were they fond of commerce. Their cities were far away from the sea. The Jews were mostly devoted to the education of their children and the observance of the law. Adding to that the peculiarity of their mode of living, they were neither known by many, nor did they constitute any material for mention in historical writings."

Josephus then undertakes another task, viz., that of invalidating the slanderous attacks made against the Jews. He proves the absurdity and ridiculousness of the libellous reports of Manethon, who had previously promised to write a history of the sacred writings of the Egyptians, wherein he says that the ancestors of the Jews had come into Egypt by many thousands, subduing the inhabitants thereof, and then conquered Judæa, &c. Later on, however, he states that a great many Egyptians, being struck with leprosy and other diseases, and compelled to leave the country, had mixed with the Jews. He invents a king by the name of Amenophis.

Josephus then dwells on the nonsensical statements of the writers, Cheremon and Lysimachus. The latter, he says, reported that Jerusalem was formerly called *Jerosyla*, a word synonymous with the Greek word, "*sacrilege*," on account of those lepers under Moses having desecrated the temple and sacred vessels. Afterwards, being ashamed of that name, they converted it into *Jerusalem*. "That childish man," says Josephus, "in his slanderous disposition, forgets that he speaks *of Jews*, not of Greeks, as with the Jews "sacrilege" is not called Jerosyla, but "Chillul."

In the second book, Josephus refutes the attacks on the faith and honour of Judaism made by Apion, who was sent by the Alexandrians to Caligula, in Rome, in order to carry on a controversy against Philo, who was at the head of the Jewish embassy at Rome.

The foolish and rancorous Apion maintained that Moses was a Heliopolitan, and, therefore, ordered prayers to be offered up within the walls of the city of Jerusalem; and that he built the whole city towards the east, where Heliopolis was situated. Instead of obelisks, he raised pillars, at the bottom of which there was a kind of boat or skiff, upon which the shadow fell from the height of the pillars, taking the course at the same time with that taken by the sun. The Israelites whom Moses brought out from Egypt, he said, were leprous, blind, and lame. That event occurred about the seventh Olympiade, in the first year of it, when the Phœnicians founded Carthage. The number of the expelled was 110,000. When they had travelled in the wilderness for six days, they got boils on certain parts of the body, and on their arrival in the land now called Judea, they rested on the seventh day, calling it *Sabbath*. They retained the Egyptian word (Sabbath), because those painful boils were called by the Egyptians *Sabbatasis*. (It is to be seen from the Plutarch what ridiculous notions the heathens had of the Sabbaths and festivals. It charges the Jews with holding Bacchanalian orgies, calls the Jewish Feast of Tabernacles, *Cadephoria*, and derives Sabbath from Bacchus.)

In the same foolish manner in which Apion attacks the religion of the Jews, he also combats their nationality. "They were," he said, "foreigners, immigrants, and unpatriotic, having interests of their own, and separate tendencies. If they were Alexandrians, why did they not worship the same gods? Why did they not erect the statues of the Imperators?" (just as some modern Apions say.)

"In their sanctuary," Apion said, "the Jews had established the head of an ass, which they adored with great reverence. That became known when Antiochus Epiphanes had plundered the temple, he having found there a very costly head, made of massive gold." Apion further relates, "Antiochus found in the temple, a man lying upon a bed, by the side of which there was a table covered with meats of land and sea birds. The king was surprised. The man entreated the king to help him, and procure his freedom. Asked by the king who he was, why he was here, and what those meats were for, the man, with tears in his eyes, told the king his unhappy fate. He said he was a Greek, and on his travelling through this country to get his living, he was seized by strange men, who took him into the temple and locked him up. Here he did not see anybody, but was supplied with the best food. At first he enjoyed that unhoped-for comfortable living, but afterwards his suspicion was aroused, and finally consternation had set in. He made enquiries of the servant waiting upon him, who told him that he was fed here, according to a law of the Jews, who did the same thing every year at a certain time, catching a Greek traveller, feeding him for a certain period, and then taking him into a forest, where they killed him, and sacrificed his body with great solemnities. They then tasted his entrails, and in offering the corpse of the Greek, they took an oath that they would ever cherish animosity against the Greeks. At last they cast the remnants of the body into a pit and withdrew."

The man then said he had but a few more days to live, and implored the king, as the head of the worshippers of the gods of the Greeks, to frustrate the counsel of the Jews, and to deliver him from his painful condition.* Apion, thinking the Jews to be idolators and drinkers of blood, wished them to embrace the faith of the Alexandrians. Apion further reproached the Jews with immolating beasts, and with not eating pork, and scorned at their rite of circumcision. It was very easy for Josephus to refute those and similar absurdities of Apion and other Judaphobists. He accomplished his task in a brilliant manner, by proving that the laws of Judaism were by no means doctrines of impiety, but those of the true fear of God; that they did not encourage hatred of man, but rather equality and fraternity; that they denounced, in strong terms, ignorance, intemperance, and idleness, teaching industry and thriftiness, disapproving of wars of aggrandizement, but promoting peaceful pursuits and the study of the law, for the sake of keeping and practising it. "I might, therefore, maintain without self-praise," Josephus says, "that we have shown a good example in most things that are excellent. For what is more excellent than not to violate the fear of God? What is more just than to abide by the laws? and what is there more useful than to live in unity and harmony with one another, not to fall out in time of misfortune, nor to be presumptuous in time of prosperity, but to despise death in time of war, and pursue trade and agriculture in time of peace, being aware of the existence of a Providence, watching over all and everywhere. Now, if others have either written these laws before or kept them better, then we, as their disciples, are greatly indebted to them; but if it is seen that we keep these laws most, and if I have proved that these laws were found first with us, then Apion and all his followers, who find pleasure in telling stories of us and insulting us, have been convicted and condemned." Josephus had shown that in the Mosaic law, God is the centre of life, and that Moses had proved that by his own life and actions. He then proceeds to the single laws, demonstrating the just and gentle spirit which prevails that legislation. But he does not stop at the legislation of the Pentateuch, but describes the Judaism of his own time. "The tenacity and perseverance," he says, "with which the Jews have adhered to this law at all times, testifies to its divine origin." Nevertheless, it cannot be denied that Josephus, in his *Apology*, made some concessions to the Greeks in many a dogmatical view. So, for instance, he does not represent Revelation as a supernatural thing, but declares it to be an outcome of a great enthusiasm. But taking him all in all, every impartial observer must own that he was a man of great learning, a man who deserves the admiration and gratitude of posterity, and a man who has won the laurels of praise and the palm of immortality. His siding with the Romans was by no means a cowardly act, but merely the outcome of an ardent desire to save his numberless coreligionists, who otherwise would have been the victims of cruelty and perdition, thus proving himself to be a lover of his faith and race.

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* I cannot forbear to mention here that that old lying blood accusation against the Jews, in connection with their religious rites, has not yet been wiped out from the minds of some wicked, fanatic, and crazy people, but now and then turns up again as a spectre, as we unfortunately live to see, even at the present moment, in spite of advanced civilisation, and in spite of the most emphatic and unqualified denial given by the greatest and most pious ecclesiastical and theological Christian authorities. It is remarkable that those accusations always turn up when a spirit of persecution of the Jews springs up in some country; and it is notoriously known that, in the course of many centuries, not a single impeachment has been proved, but in all cases the truth came to light, and the matter has been discovered to be a tissue of lies, the emanation of bigotry, spitefulness, fanaticism, and religious hatred. Who would not be reminded here of the words of Schiller, in his famous poem:—"Terrible is the fury of war, terrible are the rages of the fire and the devastations of the floods; but the most terrible of all terrible things is man in his fancy."

THE CENSUS OF 1881.

By EWING WHITTLE, M.D., M.R.I.A.

Ten years ago I read a paper on the Census of 1871, which the Council were kind enough to publish; on this occasion I wish merely to refer briefly to that article, before proceeding to the remarks which I propose to make on the recent Census.

I then showed that when the Irish people ceased to derive their sustenance solely from the potatoe, their previously rapid increase was so materially checked, that emigration was found a means not only sufficient to check their very rapid increase, but even to very largely reduce the actual numbers of the people; there was in ten years a decrease of very nearly 400,000. I showed, from the returns of the relative numbers of married and unmarried women, that the commonly received opinion that the poverty of Ireland was due to improvident marriages was a fallacy; I showed that the condition of Ireland was then steadily advancing; that the agricultural labourers were better fed than in most of the agricultural counties in England; that when land was sold in small quantities, peasant farmers came forward as purchasers, in some instances giving as much as 34 years' purchase; again, that the number of inmates in the workhouses had fallen from over five to less than one per cent. of the population. I contrasted with Ireland the rapid increase of the population in England, and their aggregation in large cities; and I drew this conclusion from my study of the Census, "that with regard to England, the rapid increase of her population, and their massing together in large centres, are circumstances that demand the anxious consideration of the economist, more particularly as affecting the important question of the relations of capital and labour."

The recent Census confirms what the two previous ones had already foreshadowed; viz.—that, with regard to the growth of population, the conditions of England and Ireland were being completely reversed; that while in Ireland the population, instead of increasing rapidly, is absolutely declining from year to year; that, on the contrary, England, instead of showing a slow increase, has begun to advance by rapid bounds, the increase in this decade being 3,256,020, bringing up the population of England and Wales to very nearly twenty-six millions, an addition to the population of more than 5,900,000 in twenty years; the rate of increase being now 14·34 per cent. The returns seem to show that the increase is mostly in the large manufacturing districts. In seven counties, ranging from Surrey to Derbyshire, the increase varies from 31 to 21 per cent. The vast increase in Surrey is clearly due to its being contiguous to London. In other counties, twenty in number, the range is from 19 to 7; in the remaining twenty-five counties, there is either a small increase, or, as is the case in fourteen, an absolute decrease. Of these it may be said that, practically, the population is stationary, ranging from +3 in Denbighshire to −3 in Brecknock; these are all agricultural counties. Taking the urban as contrasted with the rural districts, we find the population increasing in a much faster ratio—

From...	14,713,316
To	17,285,026

The increase being 2,571,710; that is nearly five-sixths of the increase in the whole kingdom, leaving little more than one-fifth of the amount as the increase throughout all the rural population; that being about half the urban, according to this table—

Urban	17,285,026
Rural	8,683,260

We cannot conclude that the great increase in the town population is solely due to the people being attracted to the towns by the prospect of more profitable employment. That the towns do drain away to some extent the natural increase in the rest of the country, is a self-evident proposition, but it will not account for the vast increase of 19 per cent. in ten years. Where, then, are we to seek for the source of this ever-swelling mass of rapidly-growing population. The following extract from an article on the School Board, in the *Daily News* of Nov. 11th, will throw some light upon the question; the writer is accompanying a School Board visitor in search of truants, and says:—

> "We steal up a narrow and broken staircase and rap at a filthy door, and then peep in; my friend has, I observe, a preference for the outside of a door; he has his own personal reasons for keeping aloof; once he has carried the smallpox to all his family, once he has been thrown neck and crop down stairs, once he has been met with the long glittering blade with which a ruffian had been slicing up wooden pipe-lights, and once he had a narrow escape of being thrown upon the fire of a lodging-house kitchen, by a score of sturdy rogues assembled there. . . . We peep in at a half-opened door, and a more dismal sight I have rarely met with. A woman, with a face pale and thin, and telling of a deal of suffering, and hopelessly afflicted with heart disease, sits on some filthy bedding on a ruinous wooden bedstead, which, with a bit of a table and a broken chair or two, constitutes the whole furniture of the room. There are six children, one in arms, the rest about 2, 5, 7, 9, and 11 respectively; the father had been thirteen weeks out of work, and three weeks ago they were turned out of their home, and all their belongings seized for rent. The forlorn little party have crept in here into furnished lodgings, and for that one hideous little black and filthy den, they are pledged to pay four and sixpence a week rent. This is in the neighbourhood of the Mint, Southwark, where extensive clearances were made some two years ago, and where those of us who have known its neighbourhood have been persuading ourselves that a great improvement had taken place; certainly the spot is more open, and possibly a good many unpleasant people have been driven elsewhere, but it is positively distressing to hear of the extortions to which these poor people are exposed. I went down into dark, fetid underground kitchens, for which the tenants were paying four

and sixpence and five shillings a week; and it is the rule here that the rent should be paid every night. 'They'll come at two o'clock in the morning, 'ammer us up if we ain't paid the eightpence,' said one old woman."

It is here, in these dens of iniquity, misery and vice, that we find the increasing masses of population ever bubbling up, while land is going out of cultivation, farms are unlet, and the vagrant and criminal classes are becoming more and more dangerous and unmanageable from year to year, and we are becoming ever still more dependent on foreign nations for our supply of food. In Ireland we find quite an opposite state of things—a decrease of more than a quarter of a million in the population. When the Census of 1871 took place, and for a few years after, Ireland, for the most part, was more prosperous than, perhaps, it had ever been before, but towards the end of last decade, several bad seasons brought about a partial famine, followed by a social condition which can only be described as chaotic. This last Census shows, at all events, that this condition cannot be ascribed to over-population. The number of the people was in

1871	5,412,377
1881	5,159,839
Decrease ...	252,538

Of this decrease considerably more than a third comes from Ulster, nearly a fourth from Leinster, less than a third from Munster, and about an eighth from Connaught. Of the four provinces, Ulster alone shows a greater decrease than in the previous decade; the very impoverished provinces of the South and West, already thinned by famine and previous emigration, afforded a more limited field for decrease by emigration than the comparatively prosperous province of Ulster. A comparison of the births and deaths in Ireland, during the decade, shows that there was actually an increase of about 400,000 in the population (previous decade, 423,000), but an emigration of over 650,000 accounts for the decrease of a quarter of a million; the decrease varies from ten per cent. of the population in North Tipperary, Carlow, and Monaghan, to 0·7 in Mayo.

The decrease in inhabited houses is as follows:—

Leinster	10,820
Munster	16,360
Ulster	12,750
Connaught	8,670

With regard to this table it is worthy of observation, that while in three of the provinces the decrease in inhabited houses has some reference to the decrease in the population, the very poor province of Connaught, in which the population is practically stationary, shows a very large diminution of inhabited houses, so proving a great increase in the destitution and misery of the people.

The decrease in the number of families is in

Leinster	16,506
Munster	25,179
Ulster	20,635
Connaught	10,699

The average number of individuals to a family is in

1871 ... 5·07; in 1881 ... 5·19.

A comparison of the two first of these tables shows about a family and a half removed from each empty house; hence we may conclude that the reduction of the numbers of the people occurred amongst the very poor, who previously lived in overcrowded hovels; a certain number of the empty houses may be accounted for by the very poorest ejected tenants, who had not the means of emigrating, crowd-ing into cheap lodgings in the towns, either in search of employment, or from having no other place of refuge; this will account for the increase of 19 per cent. in the population of Belfast, and for a small increase in some other towns, while in most of the Irish counties the Census shows a reduction, in many amounting to ten per cent., but the very poor county of Kerry shows a small increase—two per cent. I can only account for this anomaly on the presumption that the extreme poverty of the people prevented their having a fair share of the emigration that was taking place from the country generally; the same was the case with Galway and Mayo, practically the diminution in their population being only nominal, Galway, —3, and Mayo, —·7 a mere fraction. I may add the West Riding of Cork, the decrease being only 1·7.

The increase in the average number of members in each family, though not much ·12, points in the direction of the principle which I enunciated ten years ago (and which I believe that I then proved), that in the same proportion as a population are sunk in misery and all sorts of privations, in such proportion do they tend to increase. This increase in individuals in the family has only shown itself when the people were retrograding in respect of physical comforts and absolute necessities; it is very well marked in the poor county of Kerry, where there is a diminution in the number of families of 1,900, though, as shown above, there is a small increase in the population. At the same time there are 1,000 fewer inhabited houses in the county than there were in 1871. This implies that every thirty-two houses had among them to find room for an additional family, but as this overcrowding will only be among the very poor, it follows that there must be a considerable increase of misery and degradation in the county. The same state of things exists in the very poor counties of Mayo, Galway, and Clare. While the population are thus steadily diminishing, gradually approaching the ideal of political economists, viz., a man and a dog for every hundred acres, the Government returns tell us that 100,000 acres of land have gone out of cultivation.

So much for the condition (as the Census teaches us) of the labouring poor, and of cottiers on small plots of land, and who, going into the Land Court, get their rents reduced a few shillings, from six and fourpence in one case, to fifteen or twenty shillings. Of this class, the *Daily News*, of November 11th, records that in one day 160 individuals were evicted at Claremorris; these poor people get no benefit whatever from the Land Act. The same number of the *Daily News* gives a series of cases of what may be called jolly farmers, coming before the Land Court to claim to have their rents reduced. One admitted that at a sale in the neighbourhood recently, a farm of fifty acres, subject to a rent of £100, was bought by an hotel-keeper for £1,000, several farmers bidding very nearly the same amount. Another admitted that he and his father had made money on their farm; that his sisters each got a fortune of £500. A third admitted that he was pretty well off. A fourth admitted that he had done well; he had a nice little farm. A gentleman of æsthetic taste avowed that he bought his farm a few years ago because it had a nice genteel name, being called "Fort Nesbitt." A widow claimed to have her rent reduced on two farms, being the only ones she now had, but admitted that she had sold her interest in other lands, declining, however, to state what she had received for them. This is the class that will derive most benefit from the Land Act. Having got a firm hold of their land on cheap terms, these men will, if they are industrious, become rich. It is, however, to be feared that many of the small farmers (I do not mean the mere cottiers) may still live from hand to mouth, and when one or two bad years overtake them, may find themselves as badly off as ever.

As our Society is non-political, it is not within the scope of this paper even to suggest a remedy. I merely aim at setting before you the lessons that I think the Census teaches. It is not for me to say, here, whether it may prove an advantage or a disadvantage to the empire that the Irish people are being gradually eliminated from the soil of Ireland, giving place in mountain and moorland to grouse, and in the plains to cattle and sheep, the land at the same time going out of cultivation.

In England, on the other hand, we have a very different state of things; in the purely agricultural counties population either diminishing or stationary, the agricultural interest depressed, and farms offered at almost nominal rents, while the town populations are increasing enormously in every large centre of industry with such alarming rapidity, that every fluctuation in trade causes an immediate congestion of labour, bringing great misery upon the masses; even now in London, this seething mass of human misery and vice has almost got beyond the control of the magistrates and the police.

If we continue at the same rate of increase to the end of the century, we shall add about eight millions to our present population. Is our trade likely to advance in the same proportion? As yet emigration is practically *nil* as far as England is concerned, and by no possibility could it be increased to an extent sufficient to keep within bounds so rapidly growing a population as ours now is. Much is hoped for from the spread of education; but can it be expected, unaided by other means, to cope successfully with the degrading condition of life to which, unfortunately, large masses of the people are subjected in our great centres?

As searchers after truth, it is the place of such a society as this to seek out, and to call attention to, important facts. It will be the part of the politician and the economist to seek a proper remedy, if there be, as I fear, danger looming in the future, from the actual circumstances of our social relations.

As I have before shown that the Census of 1871 strongly corroborated the theory of Doubleday, viz., that population always tends to increase as people become poorer and more miserable, I have shown now that the Census just published confirms that theory, as it appears that the population has been increasing faster in Ireland during the evil times of the last, than in the two previous decades; while in England the very great increase of our population is almost entirely confined to the great centres, where vast numbers of the people live and pass their lives in conditions the very reverse of æsthetic, and where, as proved by the experiences of the School Board inspectors, wretchedly neglected and evilly-trained children swarm like rabbits in a warren. As a student of, and thinker on, political economy, I lay these facts before our Society. It is for the politician to deal with these facts practically, and show, if possible, how those evils may be averted, of which I greatly fear the coming shadows are no longer far distant.

THE NIBELUNGENLIED.

By R. McLINTOCK.

1.[*] To us in olden story many a wonder's told
Of heroes worthy glory, of mighty deeds and bold,
Of mirth and merry meetings, of woe and of tears welling,
Of keen men's strife and greetings.— List, would ye hear wonders telling!

So runs the first of the 2,500 stanzas of which the poem consists—a fit prelude to what is to follow. The second introduces the heroine:—

2. There grew in Burgundland a maid—right noble she—
Such that in all earth's lands no fairer there might be.
The name she bore was Kriemhild, she was a lovesome wife,
And for her sake did warriors full many lose their life.

4. Three kings had she to tend her, noble and of estate,
Gunther and eke Gernòt, whose fame in war was great,
And Geiselhèr the stripling, a swordman bold and rare,
The lady was their sister, the princes had her in their care.

After a long description of the glories of the court—held at *Wormes bi dem Rine*—we have the following six stanzas, which form a complete ballad in themselves, and are supposed to be the most ancient portion of the poem, still bearing traces in the original of alliteration.

13. Dwelling in this high honour it happed Kriemhild did dream:
A fair, strong tameless falcon, to be her own did seem—
Two eagles tore him from her —and she to stand and see!
To her no grief in this world than that might greater be.

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[*] The numbers attached to the stanzas agree with the numeration of Simrock's edition of the poem.

14. Then to her mother Uté her dream she straightway told,
Who little to her comfort the vision did unfold :—
"The falcon that thou heldest is sure some noble lord—
"God shield him well! or quickly thou'lt lose him by the sword!"

15. "What tell you me of lordings, O dearest mother mine?
"To live unloved of warrior it is my firm design.
"This fair life will I cherish until my death, forsooth,
"That never love of warrior shall bring me woe or ruth."

16. "Nay, promise not too lightly!" then did her mother say,
"Wilt ever in this world have joy upon thy way,
"'Must come of good man's loving— thou grow'st a lovely wife
"If God will but vouchsafe thee a good lord for thy life!"

17. "Let be, I pray, such discourse, O dearest mother mine!
"How oft have women proved it by many a certain sign,
"That love's reward is sorrow after its fleeting bliss!
"I would know nought of either, and so know nought amiss."

18. Thus Kriemhild of all loving was minded keep her free,
And long fair days and many the fair one lived to see
Ere that she knew of any to fill with love her life,
But after with much honour was a worthy warrior's wife.

The author—or compiler—accepts the interpretation put upon the dream by Kriemhild's mother, and applies it to the hero, Siegfried, whom we presently see receiving knighthood at a great festival held by his father, King Sigmund, of Santen in the Netherland.

80. And all that might be gathered who knightly arms should bear,
Being of knightly kindred, each noble childe and fair,
Unto the land was bidden, and to the high feast-tide,
And there was girt and sworded at the young King Siegfried's side.

Being urged to think of marrying, Siegfried declares his heart to be set on Kriemhild—whom, however, he knows only by report. After some vain opposition, his father offers him an escort sufficient to protect him in case Gunther, Kriemhild's brother, should take his wooing ill—for the mettle of Gunther and his terrible vassal Hagen is well known. Siegfried declines.

62. "Fain am I to win her with my own sole hand.
"With warriors but a dozen will I to Gunther's land.
"Therefore, Father Sigmund, should thou help me on my way."
And then they gave his followers for weed both grey and gay.

On their arrival at Gunther's court, Hagen of Trŏnje—a great traveller and a terrible fighting man, is made to give an account of Siegfried's great deeds—how he went to Niblungland, slew the two young princes, Schilbung and Niblung, took possession of their lands, their mighty hoard of treasure, and their father's good sword, Balmung, and further, how he killed a dragon and made himself invulnerable by bathing in its blood. This seems to be an interpolation or an after-thought, for it interrupts the main action, and does not fit well into what has gone before. On meeting Gunther, Siegfried says no word of Kriemhild, but challenges him to fight for their joint heritages. But Gernŏt, Gunther's brother, contrives to avert the strife, and Siegfried remains as a guest, and takes part in all the knightly exercises of the court.

187. Whatso might be the pastime found Siegfried unafraid,
Within his heart he cherished a fair and lovesome maid,
As him the lady cherished, whom yet he had not seen,
Kind thoughts she thought in secret that she for him did mean.

138. When to their courtyard pastimes the young men them betook,
Knight and knave together, full oft would Kriemhild look
Down on them from her window, the lovely queen on high,
And for no other pastime thought she then to breathe a sigh.

And so a year goes by. Then tidings are brought that Lüdeger and Lüdegast, Kings of Saxony and Denmark, are about to make a raid on the land. Siegfried volunteers to lead Gunther's army against them, defeats and takes them prisoners. Swift runners are sent with the news, and Kriemhild has one of them up to her chamber that she may question him herself; and this is what he says:—

232. "Aye foremost in the battle, no man did ride so well,
"Most gracious noble lady, if I the truth shall tell,
"As he our guest of mettle from out the Netherland.
"For wrought was many a wonder by brave Siegfried's good right hand."

At the feast held to celebrate the victory, Gunther takes counsel as to how he may worthily honour the day.

279. Then up and spake full freely the swordman Ortewein:—
"If that to do full honour to the feast ye do incline,
"I rede bid forth the maidens, so fair and eke so dear,
"Who dwell in so high honour among us Burgunds here.

280. "What were bold warriors' pleasure, how should they grace their lives,
"If fair maids were a-wanting and fair and stately wives?
"Therefore bid forth your sister to stand before your guest."
That counsel put rejoicing in many a hero's breast.

Gunther knows of Siegfried's love, and he gives the suggested order. After this Siegfried and Kriemhild are constantly together, and—

301. In that tide of summer, the merry time of May,
No longer in his heart's depth could Siegfried hide away
The joy that wholly filled him, the joy that loving brought,
When at his side she wandered whose love his heart had sought.

And then—

303. From whatso land or kingdom the guests came who were there,
No eyes or ears had any save for that lovely pair.
And she had leave to kiss him, that warrior stark and bold—
For him no dearer pleasure could all the wide world hold.

But love is blind—and Siegfried sees so little of the impression he has made, that he is actually on the point of returning home without telling his love. But—as we can well understand—Geiselhèr, Kriemhild's youngest brother, has no great difficulty in persuading him to stay.

Shortly after this Gunther proposes to go wooing to Brünhild, an Icelandic princess, of surpassing beauty and fabulous bodily strength, who insists that the man who desires to win her must, on pain of death, vanquish her in three successive trials of strength. Hagen advises that Siegfried should be invited to accompany and assist Gunther.

342. "Wilt thou, Siegfried, help me," then did Gunther say,
"To woo this lovely maiden? Do this thing I pray,
"And if I win for housemate this full lordly wife,
"For thy sake will I venture honour, goods, and life!"

343. Thereto made answer Siegfried, Sigmund's bold son:—
"Givest thou me thy sister— then shall thy will be done—
"The fair and noble Kriemhild, a queen both high and rare—
"Then for no wages other for my labours will I care."

The bargain is struck, and with only two companions more they sail down the Rhine, and in twelve days reach Iceland. The trial of strength begins at once—the tests chosen by the queen being throwing a heavy spear against the opponent's shield, casting an enormous stone, and leaping after it. Gunther receives the lady's spear on his shield—which is smashed—catches, reverses, and sends it back so deftly, yet so forcibly, that, though struck only by the shaft, the lady is overthrown. In the other trials—hurling the stone and leaping—Gunther surpasses her. But it is really Siegfried—who has been introduced as one of Gunther's vassals—who does the work, Gunther only pretending. For Siegfried possesses a *Tarnkappe*, or cloak of darkness, which not only makes him invisible, but gives him the strength of twelve men. He it is who catches the spear and returns it, hurls the stone and leaps the long leap, carrying Gunther with him. Thus the battle is won—Brünhild submits, and it is arranged that she and Gunther, Kriemhild and Siegfried shall be wedded so soon as they come together in Burgundland. The assembly of Brünhild's kinsmen alarms Hagen a little, and Siegfried goes off in his *tarnkappe* to Niblungland, which he reaches in a day and a night, and returns with a thousand chosen warriors for an escort. With these, and "twenty hundred men" of Brünhild's, they set sail, and reach Worms in safety, and the marriages are solemnised with great pomp. But after the ceremony, Siegfried's aid has to be once more called in, and a wrestling match with the lady takes place, in which Siegfried's supernatural strength again gives Gunther the semblance of victory. Even Siegfried finds Brünhild an awkward adversary; the struggle is very severe, and as a sort of memento of it he carries off the lady's girdle and ring, which, without any explanation, he hands over to his own wife, and are afterwards the occasion of much woe.

Time rolls on—King Sigmund resigns his crown to his son, to whom, twelve years after his marriage, is born a son, who is called Gunther, in honour of his uncle. Away in Burgundy, Brünhild, too, has borne her lord a son, who, in memory of old times, is called Siegfried. From this situation the story makes a new start.

746. Each day thought Gunther's wife, and in her heart thus said:—
"How comes it that Dame Kriemhild bears up so high her head?
"Siegfried, her husband, is vassal to my lord—
"But for long right little service hath he done with gold or sword."

She accordingly suggests that Gunther should send them an invitation to his court, and to Gunther's objection to the distance, answers scornfully:—

750. "However high and mighty a king's sworn man may be,
"What thing his lord may bid him, to leave he is not free."
Then fain to smile was Gunther, to hear her talk so free—
He looked for nought of service, oft as Siegfried he might see.

But after a little persuasion, Gunther, nothing loth in reality, sends the invitation, which is accepted. Soon Siegfried and Kriemhild, with old King Sigmund and a great retinue, arrive; and great festivities are held in their honour. At the games, just before vespers, one evening—

840. There they sat together, those queens so rich and great,
Thinking on two warriors, men of fame and state.
And then up-spake fair Kriemhild:— "Such a man is mine,
"These are but fit to serve him that here so brightly shine."

841. Then answer made Dame Brünhild :— "How might such thing be?
"If others none were living, but only thou and he,
"Then might well these nobles bend beneath his sway;
"But that may happen never while Gunther sees the day!"

844. Once again spake Kriemhild :— "So worthy is my man,
"That not without good reason to praise him I began.
"In ways and manners many his name and fame are great—
"Brünhild, wilt thou but own it, he well is Gunther's mate."

845. "Nay, Kriemhild, nay, thou should'st not thus take my words amiss!
"For I also not causeless have spoke my mind in this.
"I heard them both affirm it when them I first did see,
"What time the king thy brother had victory over me—

846. "When for my love those trials so manlike he began,
"Then did say Siegfried he was the king's sworn man.
"I held him for our liegeman since that I heard him say."
Then answer made fair Kriemhild :— "That were an evil day!

847. "How could my noble brother so make choice for me,
"That I of any liegeman the housemate meek should be?
"Therefore will I, Brünhild, full friendlike thee beseech,
"For my sake and for manners, to leave such hurtful speech.

850. "Truly, I have to wonder, since he thy liegeman is,
"And thou hast rule and lordship over him and his—
"Wherefore withholds he tribute —or by what pretence?
"Nay, with thy overweening I could right well dispense."

851. "Thou ratest thyself too dearly," then spake the kingly wife,
"Full fain am I to see it, if folk do hold thy life
"For worthy of so high honour as that they shew to me."
Both now were full of anger, as all might plainly see.

852. Then spake the lady Kriemhild:— "Let that be as it may!
"Since thou my man as liegeman dost claim in face of day,
"This day shall every liegeman of both the kings here know
"Whether before the king's wife to church I dare to go!

856. "Now deck yourselves, my maidens!" then said Siegfried's wife,
"Let no shame here befall me, my body or my life!
"If ye have weeds full costly, let them be seen this day—
"She shall be fain unsay it that she but now did say!"

At the church door Brünhild bids Kriemhild stand back and let her pass—

864. Then spake the lovely Kriemhild —full angry was her mood—
"If thou could'st but keep silence, it might be for thy good—
"Thou whose deeds have sullied thy fair self and thy life—
"How may the vassal's harlot become a true king's wife?"

And she produces the ring and girdle which she declares her husband gave her. Gunther and Siegfried are sent for, and the latter denies the truth of the charge made by his wife, and offers to take a solemn oath to confirm his word. At the same time he apologises for his wife's indiscretion—women should be taught to avoid superfluous talking—and advises Gunther to impose silence on his wife, as he means to do with Kriemhild, being quite ashamed of her conduct. We learn afterwards from Kriemhild herself that she suffered personal chastisement at her husband's hands. Peace is thus apparently restored. But Hagen broods over the insult offered to Gunther's wife, and he whispers continually in Gunther's ear—ineffectually at first—that were Siegfried but out of the way many rich territories would fall under Gunther's sway. Gunther at last yields to the tempter. A false alarm of war is got up, and Siegfried volunteers once more to lead Gunther's army. When all is ready, news is brought that the supposed enemy has laid down his arms, and Hagen proposes a great hunt with the forces raised for war. Before setting out he pays a visit to Kriemhild, pretends great affection and solicitude for Siegfried, and learns from her that when Siegfried took his case-hardening bath of dragon's blood, one spot between his shoulders was accidentally left unhardened. At Hagen's suggestion she marks this spot on her husband's clothing with a little cross of silk, and begs Hagen not to let her husband pay for her misconduct towards Brünhild. Hagen replies that the ladies have been reconciled since that, leaving her to infer that there can be no ill-will now. After a hard day's hunting, in which Siegfried particularly distinguishes himself—his concluding exploits being the capture of a bear and the slaying of it at the camp—when supper is served it is found that the wine has been forgotten, and Hagen confesses that he has sent it to the wrong place in the wood. However, he says, there is a spring of good water not far off, and he proposes that Siegfried shall shew his speed of foot by running a race with him and Gunther to the well. Siegfried assents, and allows them to strip to their shirts, while he retains his full clothing and arms—spear, shield, bow, and sword. Of course he arrives first at the well, but he will not drink before the king. So he leans his spear against a tree, lays down bow and sword and shield, and waits. But he pays dearly for his courtesy. As he at last stoops to drink, Hagen smites him with his own spear through the silken cross—first taking the precaution of throwing the bow and sword into the thicket. And then he runs as he never ran before. But Siegfried, wounded as he is, snatches up his shield, overtakes and fells Hagen, almost shattering the shield with the force of the blow. But his strength fails—he falls—and the men crowd round and watch him as his life-blood runs away. The more true-hearted pity him, and even Gunther is moved.

1021. Then up and spake grim Hagen:— "I see no cause for tears—
"Now are our troubles over, fled all our cares and fears.
"Few shall we henceforth find them who us will dare withstand—
"Joy rather that *his* lordship is ended by my hand."

But in spite of all, Siegfried commends his wife to Gunther's care.

1026. "Let it be her profit to have a brother's heed—
"For sake of princely virtue, stand by her in her need!
"My father and my vassals— 'twill be long ere home I go—
"Never was wrought on woman through her love so deep a woe."

1027. And bitterly he wrestled as one in direst need,
And woeful words did utter:— "This foul and false-wrought deed
"Surely ye yet shall rue it in the days that darkly loom—
"I rede you look well to it —yourselves have wrought your doom."

These are his last words. Hagen says he cares not who knows how he met his death, and causes the dead man to be laid outside the door of Kriemhild's lodging. When word is brought to Kriemhild that a dead man is lying at her door, she remembers Hagen's questions, and she guesses the truth. Her lamentation over her husband's body quickly attracts a crowd—even Hagen and Gunther appear.

1072. "O sister, for thy sorrow," the king said, "woe is me!
"And woe that from such sorrow ourselves may not go free!
"For still must we have sorrow for the loss of Siegfried's life."
"Small cause have ye for sorrow!" said the heavy-hearted wife.

1073. "Had this been to your sorrow, surely it ne'er had been!
"Yet am I fain to fancy ye did forget the teen
"That must be mine if sundered from him who here lies low—
"If God in Heaven had willed it, His hand had dealt the blow."

Siegfried's wound begins to bleed anew at the approach of Hagen, and Kriemhild charges him and Gunther with the murder.

1078. And yet again spake Kriemhild:— "Help me bear this woe!"
Then came and stood beside her, all where her dead lay low,
Gernòt, her brother, and Geiselhèr, young and kind;
And they in truth bewailed him 'till there eyes with tears were blind.

Siegfried is buried, and his old father, Sigmund, returns home, while Kriemhild is prevailed upon by her mother and younger brother to remain with them, and for four years she sees neither Gunther nor Hagen. But Gunther—again at Hagen's prompting—seeks a reconciliation, in order that the great Niblung treasure—Kriemhild's "morning gift" from her husband—may be brought into his land. But Kriemhild with it is rich, and therefore terrible; and Hagen suggests how foolish it is to leave such a treasure in the hands of any woman. But Gunther replies that she is his sister, and he has sworn an oath—Hagen says:—"Let the guilt be mine!" And by fraud he gets possession of the treasure and sinks it in the Rhine. After this, Kriemhild causes her husband's body to be removed from the Minster at Worms, and is preparing herself to quit the scene of so many troubles, when news comes which gives a new turn to events.

1187. It was about that season wherein Queen Helké died
That turned the mind of Etzel to win another bride.
By friends he was well counselled to look to Burgundland,
Where dwelt a well-born widow, Kriemhild, well worth his hand.

1188. What time that death had ended the lovely Helké's life,
They whispered:—"Would he ever again have noble wife,
"The best and highest housemate that e'er did king reward—
"Then let him take this lady —stark Siegfried was of old her lord."

1189. Then spake the mighty king out:— "How may this come to pass?
"A heathen I—unbaptised —no kneeler at the mass—
"And she a Christian lady —she will not yoke with me.
"Ye will have wrought a wonder if this thing ye make to be."

Etzel is known to history as Attila, King of the Huns. He sends an old acquaintance of the Burgund royal family—Rüdiger of Bechelaren—to demand the hand of Kriemhild. Hagen alone opposes the match, but is overridden by the brothers, who leave Kriemhild to decide for herself whether to accept the offer or not. She is informed of Rüdiger's arrival.

1269. Kriemhild, she most wretched, and sad of heart and mood,
Awaited Rüdiger, the noble herald good.
He found her in the raiment that served her every day,
Though they that were her household had weed both rich and gay.

She hears his message—takes a night to consider the matter—Etzel is a heathen—but in the end she accepts his offer, and returns with Rüdiger to Hunland. On her way she pays a visit to her uncle, Bishop Pilgrim of Passau, who strongly urges upon her the duty of converting her new husband to Christianity. There is no need to dwell on her journey—royal progresses have not changed so much as some other things between that time and this. Her husband and his people receive her with all possible magnificence and honour, and she lives happily with Etzel for seven long years, at the end of which time she gives birth to a son, whom she causes to be baptised Ortlieb. Then six more years go by, and Kriemhild wins the love of all the Huns. But all the while she mourns in secret for Siegfried, and resents that she should have been driven to wed a heathen. She thirsts for vengeance, and persuades Etzel to invite her brothers to visit him. Before the messengers start she sees them privately, and suggests that Hagen can shew her brothers the way, for he has known it since his childhood. On their arrival at Worms—

1488. So rich the gear they rode in, and made by so cunning hand,
That they with all due honour before the king might stand.
But that would serve no longer in court on such a day—
Their robes—who would might wear them, the messengers did say.

So they deck themselves yet more finely, and Hagen introduces them to the king. The brothers overrule Hagen, and resolve to accept the invitation. But they are prudent enough to go well armed and escorted. Among the nobles who answer their summons is Volker of Alzeie, introduced thus:—

1531. Now who was this same Volker straight will I let you know.
He was a lord right noble, and under him did go
Many a Burgund swordman for skill and boldness famed,
And for that he could fiddle, he was the "playman" named.

On the return of the messengers, Kriemhild asks which of her kinsmen are coming, and particularly what Hagen said.

1554. "He came betimes one morning, that they did counsel take,
"The words were little kindly that he that morning spake;
"And when that they did promise to ride in Hunnish land,
"Then did grim Hagen tell them their death was on their hand.

1555. "The kings are surely coming, your brothers, all the three,
"In guise and mood full lordly. Who else with them may be,
"The names and numbers of them are scarcely to be told,
"But promised for the journey is Volker, the playman bold."

1556. "Well could I do without it," so spake the kingly wife,
"That here my lips should welcome Volker in my life—
"But fain would I grace Hagen —he is a swordman good,
"And that he will come hither makes me in joyful mood."

1557. Then turned the queenly lady where her lord she found—
How loving and how wifelike Dame Kriemhild's words did sound!
"How like you of my tidings, O dearest husband mine?
"That surely now will happen wherefor my heart did pine!"

1558. "Thy will, it is my pleasure," spake the king straightway,
"Never have my own kindred made me so bright a day
"With tidings of their coming, when they my land have sought;
"For joy of these thy kinsmen my care is shrunk to nought."

The story now returns to the three brothers, who are ready to start with a following of over 10,000 men. Dame Uté has a dream, and tries to detain her sons. But

1564. "Whoso puts trust in dreaming," straight did Hagen say,
"Will not know right the story to tell upon the day
"When it shall come to asking how may his honour stand,
"And like my lord my counsel, full swift he'll quit this land."

Hagen has been brought to this point by Gernôt's taunting reminder of Siegfried's death. Even Brünhild's last effort to detain her husband fails, and the little army starts. A thousand Niblungs accompany the Burgunds; but from this point in the story the names are used with nearly equal frequency, and apparently indiscriminately. A chaplain goes to sing mass before the king. On the twelfth morning after leaving Worms, the Danube is reached, but the river is in flood, and no ferryman visible. Hagen sets out to find one, and, guided by a sound of splashing water, comes upon a party of "wise women" cooling themselves in a spring.

1592. So soon as he espied them, he drew in ambush nigh,
And they, at his approaching, full swift away did fly.
To scape from him so easy did give them mickle joy.
Straightway he seized their garments, but wrought no more annoy.

1593. Then spake one of the meerwives —Hadburg was her name—
"We give unto your knowing, O Hagen, knight of fame!

"If so thou wilt but yield us our hostage weed again—
"The fortunes of your riding among the Hunnish men."

1594. Like fair white birds they hovered before him on the flood,
Thereat was he persuaded their rede was firm and good.
And whatso they should tell him took all the more for true.
The knowledge that he prayed for full soon of them he knew.

Hadburg promises him a prosperous journey, and in return he gives up the clothing. Then Sigelind, another of the women, tells him that her companion has lied to him—all who go forward take death in their hands—none will return save the chaplain. Hagen angrily demands means to cross the water, and she directs him to the ferryman's house. The ferryman proving surly, Hagen kills him and takes possession of his boat. During the ferryage of the troops across, Hagen catches sight of the priest, whom he at once throws overboard, and even thrusts away from the boat with an oar. The priest, though no swimmer, by God's help, reaches the side of the river from which they set out, and Hagen perceives that the meerwife has told the truth. The work over, he breaks up the boat and sends the pieces adrift—there shall be no retreat. He tells Gunther of the prediction and of his effort to falsify it by drowning the priest, and advises a good watch to be kept. During the night they are set upon by Gelfrat—the lord whose ferryman Hagen has killed—but Gelfrat and a hundred of his men are killed, while the travellers lose only four. At the Hunnish border they are warned that no friendly reception awaits them, but they press on, only making a short stay in Rüdiger's castle for messengers to go to Etzel. The stay, however, is long enough for Geiselhèr, the youngest of the three kings, to be betrothed to Rüdiger's daughter. An old man named Hildebrand, whom Kriemhild sends to meet her brothers, warns them to beware of entering a certain house which for two years past has been prepared for them. It contains three hollow reeds or tubes, charged with sulphur and coals, which are to be fired as they sit at meat—a sort of anticipation of Gunpowder Plot. Presently Dietrich of Berne—Theodoric of Verona—appears and repeats the warning that Kriemhild is bent on avenging her first husband. But there is no returning now.

1826. And then Kriemhild, the fair one, with her household went,
And there received those swordmen with false and foul intent.
She kissed her youngest brother, and took him by the hand—
Which Hagen of Tronje seeing, drew hard his helmet's band.

She forbids the men to take their weapons with them into the hall, and offers to take charge of them herself. Hagen answers :—

1836. "I look for no such honour, princess mild and fair,
"That you into the storehouse my heavy shield should bear,
"Or other my apparel. You are a mighty queen—
"My father taught me manners. I tend myself, I ween!"

Dietrich confounds her by avowing that he has betrayed her counsel, and Etzel, from a distance, seeing him and Hagen grasp each other's hands, asks who it is that talks with Dietrich. Hearing Hagen's name, he remembers having known his father.

1846. "Therefore I am acquainted with Hagen who stands there,
"Two boys I held as pledges —they both were brave and fair,
"He and the Spaniard Walter —they grew up in this stead—
"Home I sent young Hagen, Walter with Hildegund fled."

A little later Kriemhild provokes Hagen into an open avowal of the murder of Siegfried, and, turning to her men, says she cares little now what may befall Hagen. But they have too great a respect for the terrible Hagen and his fiddling companion, Volker, to make an attack.

During the night which follows, a treacherous onslaught by some of Kriemhild's men is baulked by the watchfulness of Hagen and Volker. In the morning they all go to church in battle array—Hagen declares it their last opportunity of hearing mass. After church there is some impromptu jousting, and Volker accidentally kills a man, but Etzel, who has been looking on from a window, declares it to be an accident, and forbids the exaction of vengeance. At the dinner which follows, Kriemhild's son, Ortlieb, is exhibited to the princes, and just as he is being passed round, Dankwart, Hagen's brother, rushes in covered with blood—Gunther's men have been set upon by Kriemhild's contrivance, and all are dead but he who brings the tale. Hagen draws his sword,—and the child's head rolls in the mother's lap. Dietrich of Berne obtains leave, in the midst of the slaughter which follows this signal, to withdraw—the Burgunds have no quarrel with him, for he warned them of the treachery awaiting them, and he takes Etzel and Kriemhild with him. After this the slaughter goes on with but slight intermission all through the rest of the day and the night. The hall is fired, but, being vaulted, resists the flames. In one of the intervals—chieftain after chieftain bringing up his men to perish in an attack on the building which the Burgunds have turned into a fortress—Kriemhild, who, strangely enough, is present outside, urges the Huns not to allow breathing time to the enemy, saying:—

2210. "If others none were living but the sons of Uté fair,
"And might my noble brothers but come into the air

"To cool their glowing harness —then were ye men forlorn—
"For never keener swordmen into the world were born."

So it goes on until Gunther and Hagen alone remain, and to put an end to it, Dietrich at last goes into the hall, and in succession vanquishes and leads them, bound, to Kriemhild. She causes them to be put in separate confinement, and after a while pays a visit to Hagen, whom she tries to induce to restore to her the Niblung Hoard. But he has sworn an oath not to reveal where it lies while one of her brothers lives. She straightway has Gunther put to death, and herself carries his head to Hagen. The secret is now known only to himself and God, and shall never be told to a she-devil. In a rage she draws Hagen's sword—Siegfried's sword Balmung—and Hagen's head falls at her feet. Etzel, Dietrich, and Hildebrand are witnesses of this terrible deed, and Hildebrand avenges it by hewing Kriemhild in pieces.

2294. No more have I to tell you of the mighty woe—
Those who there lay slaughtered, still let them lie a-low—
Nor how the Hunnish people have fared since that day.
Here makes an end the story. This is the Niblung lay.

The Chinese are by no means alone in the practice of ancestor-worship; they only differ a little in method from the rest of the civilised world. We, too—although it seems likely that the fashion may change in the future—we, too, have worshipped our ancestors. And when we look back along the path of history towards its far-off vanishing point, we still see our earliest forefathers worshipping their ancestors with song and spoken word. Some few fragments of antique song and speech have lived to reach our ears, but too often they sound confused and incoherent. At intervals along the path of history, however, stand works of art, built up from the rough, chipped, and worn stones quarried from the ruined edifices of former days. Constructive hands and minds have picked and chosen, divided, joined, carved and smoothed, until the separate stones have lost their independent existence or merged it in a higher one. Such a work of art we have in Tennyson's "Idylls of the King," and such a work of art is the "Nibelungenlied."

In the form in which we possess it, the Nibelungenlied dates from the end of the twelfth or beginning of the thirteenth century, but it existed in some form for some centuries before that time. Bishop Pilgrim of Passau (A.D. 970–991) caused the story to be written down in Latin prose. (It may be noted, in passing, that Kriemhild's uncle in the story is also Bishop Pilgrim of Passau.) And Siegfried is clearly identical with the Sigurd of the "Elder Edda," an Icelandic or Norse compilation, believed to have been made somewhere between the sixth and eighth centuries. Between the Edda and the Nibelungenlied there is this remarkable difference, that while in the former everything is superhuman and supernatural, in the latter the supernatural is reduced to a minimum, and really has very little effect on the story. Sigurd, in the Edda, is descended from Odin, and Niflheim—the Niblungland of the work before us—is the depth of the ocean and the realm of the departed. Brynhild or Brünhild is a Walkyrie, and the great hoard, which brings death to all its possessors, has been fished up from Niflheim by the gods Odin, Loki, and Hönir. But as if to put it beyond doubt that the story is identical with that of the Nibelungenlied, Sigurd's wife, here called Gudrun, is represented as after his death marrying Atli or Attila. It is thought that in a still older version of the story, Sigurd may have been the Spring or Sun God himself, swiftly and in hero-guise traversing the earth and freeing it from monsters and the powers of ancient night. If this supposition is well founded, we have in the Nibelungenlied a remarkable instance of the condensation and humanisation of an elemental abstraction quite opposed to a once popular theory that the heathen gods were but deified men.

Of the authorship of the Nibelungenlied nothing is known; behind this "Northern Iliad," as it has been called, there is no Northern Homer whose existence can be disputed. Like the Iliad, the Nibelungenlied is supposed to have been originally a series of separate ballads—one of which is supposed to be contained intact and with traces of the original alliterative verse still visible— in the six consecutive stanzas of Kriemhild's Dream, which I have given entire. And there are circumstances which almost induce me to believe that even in the final form in which we possess the work, it is not the work of one hand, but of two or more, and that notwithstanding the unity and continuity of the story and the uniformity of the literary style. In the first place, there is a new beginning made halfway through the story, where Etzel is introduced for the first time:—

1187. It was about that season wherein Queen Helké died
That turned the mind of Etzel to win another bride;
By friends he was well counselled to look to Burgundland,
Where dwelt a well-born widow, Kriemhild—well worth his hand.

Further, there are MSS. which contain only this latter half—in those called "Kriemhild's Vengeance,"—coupled with another poem, called the "KLAGE" or "Lament." These two were actually the first to find their way into print. If this were all, it might very well be that one author had written the two parts as separate, but complementary, works.

But there are oversights and inconsistencies which to my mind make it almost impossible that one man should have written the whole.

In the first place, there is the immense period of time covered by the story. Take the landmarks in Kriemhild's life:—Siegfried is a year in her brother's court before he sees her; then there is an undefined period which includes the trip to Iceland; twelve years of married life before the birth of her son Gunther; another undefined period between the birth of the child and Siegfried's death; from Siegfried's death to Etzel's wooing, thirteen years; from her marriage with Etzel to the invitation sent to her brothers, thirteen years again—in all, something like forty years. As in the very beginning of the story, her mother says to her,

"Thou growest a lovely wife,
"If God will but vouchsafe thee a good lord for thy life,"

and as it is distinctly a northern story, we can scarcely think of her as being less than eighteen years of age, which would make her fifty-eight at the end. But to the very last she is still "the beautiful," and evidently imagined in the prime of life in spite of all her trials. And her brother Geiselhèr is introduced at the very outset as *ein waetlîcher degen*—a valiant thane—but to the very end he is *Gîselhêr das kint*—Childe Geiselhèr—and some effect of pathos is obtained by the breaking off of his love-match with Rüdiger's daughter, when he must have been between fifty and sixty years of age.

In the second place, Dankwart, Hagen's brother, is represented as holding an important office in Gunther's household when Siegfried first visits it, some thirteen years before the murder. Yet when Blödel, by Kriemhild's order, goes to pick a quarrel with him, and insinuates he had a hand in Siegfried's death—

2027. "Not so, Master Blödel," Dankwart then did say,
"Else had we cause for rueing our journey here to-day.
"I then was but a small child when Siegfried lost his life;
"I know nought of offence done unto King Etzel's wife."

And the whole character of the work puts it out of the question that Dankwart should tell a wilful lie.

Now, it seems to me that such oversights as these are just what a second writer would be likely to make in continuing a story begun by another, especially in those days, when books were scarce and memory had to fill their place. And, on the other hand, I cannot imagine them being made by a man who had *written* the first part, particularly the slip about Dankwart. As to the character drawing, there is no such subtlety about it as to make any great difficulty. If it were not for Hagen, I should be inclined to say that there was but little individuality in the figures. If Hagen were an original character in the Nibelungenlied, the creation would be almost fit to take rank beside Iago, and would certainly count as an argument against a dual or divided authorship. But such is not the case. We know who it was who drew Hagen in the first place, with his capacity for boundless fidelity and treachery, and it is not at all likely that the Latin-writing monkish author of the *Waltherilied* also wrote the Nibelungenlied. Therefore two writers could handle the character of Hagen—and if two, why not more? As regards the literary style of the Nibelungenlied, uniform as it is from beginning to end, it is not of a character to militate against a theory of duality or even plurality of authorship. It is a highly artificial and conventional style, and yet—if such a thing can be—remarkably artless in its convention and artifice. Words, phrases, and rhymes are, so to say, stereotyped, and recur on every page and almost in every stanza, till the effect is like that of a long series of Egyptian pictures, with their want of perspective, their angular figures, and attitudes repeated *ad infinitum.* It is not very difficult to reproduce this archaic stiffness—a certain number of formulas have to be learnt and consistently applied—and in the case of a supposed second writer for the Nibelungenlied, there would scarcely need any learning, for the formulas would be the current poetical language of the time, and quite sufficient to express the very limited number of ideas which had to be provided for. The specimens which I have given in English will serve to shew the artless nature of the composition, but not to exhibit the extent to which, in a complete translation, a technical or conventional vocabulary and diction would have to be invented and rigidly adhered to in order to yield the right effect.

Gunther and Etzel are historical figures. Gunther of Burgundy was vanquished and killed in battle by Attila, in A.D. 450, not in "Hunland," but on his own ground. Attila himself died in 453.

One point to note about the Nibelungenlied and all the legends of Germany, is that their antiquity is after all not very great. They are all Christian, at least on the surface. There are absolutely no literary pre-Christian remains in Germany. But the Christianity of the Nibelungenlied is soon felt to be only superficial; its spirit is thoroughly un-Christian, though not anti-Christian, which is fully accounted for when we learn from the Edda that it is really a heathen subject re-worked in Christian times, and humanised, as I said before.

It will be evident from what I have said, and from the specimens that I have given, that the poetry of the Nibelungenlied is not to be found in isolated lines and passages; in this respect it is immeasurably behind the classic poetry of Greece. But I venture to think that as a story of lasting human love, and equally lasting hate, its interest is equal to that of any story ever written. We feel real human hearts beating in those stiffly outlined figures—no gods or demi-gods truly, but creatures much more accessible to our sympathy. And through the whole work there is no hint of adverse fate—all is wrought out by the free human wills and passions of the actors. Yet life was hard to those early ancestors of ours—harder than in Greece, where even gods had to bow to fate. 'Tis strange.

THE TURVEY AMMONITE.

On an internal cast of the body cavity of the shell of an Ammonite, exhibiting remains of the coriaceous margin of the hood of the animal.

BY THE REV. HENRY H. HIGGINS, M.A.

THE Ammonite which forms the subject of the following notes was found about three or four years ago, in a clay-pit, situated in the hamlet of Warrington, Bucks, about two miles from Turvey. The locality is coloured on the Ordnance Survey as pertaining to the Great Oolite. Two quarries in the same neighbourhood are marked upon the map, one at the intersection of roads from Olney to Wellingborough and from Bedford to Northampton; the other, three-quarters of a mile to the south-west. In the former, the limestone is laminated and much coloured by iron, the thicker stones having a hard blue nucleus. *Ammonites Bechei* (Sow.) abounds, and with it are several large bivalves. The limestone in the other quarry is more compact, uncoloured by iron, and supports a white marl, in which the shells of Brachiopoda, &c., are beautifully preserved.

In a depression between the two quarries was formerly a clay-pit, which is now filled up. An intelligent labourer told me that, about three years previously, a few fine fossils had been found in this clay-pit, and had become the property of T. Hipwell, Esq., of Olney, by whose liberality the interesting specimen here figured was contributed to the Liverpool Museum. It had been exposed on a rockery for more than two years, and it seems quite probable that this exposure to wind, rain and frost had brought out certain characters, which made me, on first seeing it, very desirous of submitting the specimen to further examination. It is about fourteen inches in diameter, and weighs about twenty-five pounds.

The following observations must be regarded as wholly provisional. Their chief value may be in suggesting to curators and collectors of Ammonites the possible significance of characters in their specimens previously less noticed. Only after the careful comparison of many such observations will it be possible to regard the malacology of the Ammonite as even approximately ascertained.

The terminal appendage, seen at (*f*), Plate I., Fig. 1., has been touched with gum-water, in order that it might be more distinctly seen in the photograph. The rest of the specimen has not been "assisted" in any way.

The first peculiarity to which attention may be called is a dark, undulating, elevated, line or ridge, seen in Fig. 1, commencing a little below (*a*), and proceeding by (*b*) to (*c*), where a chip or wedge of the matrix has fallen out, disconnecting the lateral line or ridge from its transverse portion shown at (*d*). There can, I think, be no doubt that the ridge has been continuous. Its character is best seen at (*d*). It thins out a little below (*a*), but traces of a similar line are seen much further back, near (*g*).

What is the nature of this line? It seems to have some relation with the lateral prominences marking the chambered part of the shell, for it fines off into the side of the last shelly prominence, and has two culminations corresponding with the two succeeding lateral prominences.

Much denudation has, apparently, been effected by the long exposure of the specimen to the weather. The matrix, in the portion of the specimen supposed to answer to the soft parts of the animal, differs very distinctly from the harder, bluish-grey, clay attached to some portions of the shell.

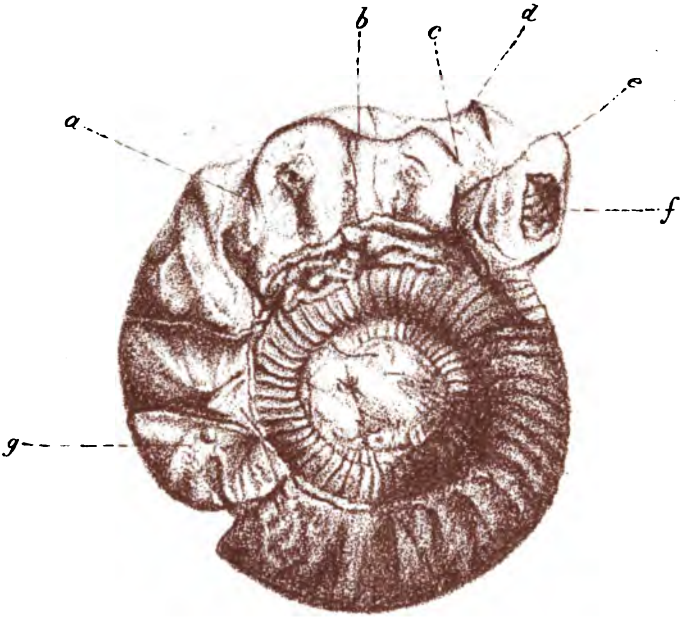

Fig 1.

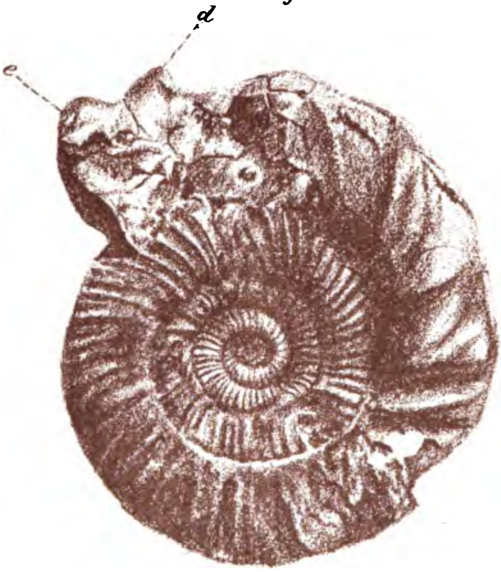

Fig 2

J. Chard, Delt.

Fig. 1. (*a. a.*) The two coriaceous side-lobes of the hood in *Nautilus;* supposed to correspond with the two valves in the *Aptychus* of *Ammonites.*

(*b. b.*) The central area of the hood in *Nautilus;* supposed to correspond with the hood in *Ammonites.*

(*c. c.*) The anterior extremity of the central area of the hood in *Nautilus;* supposed to correspond with the ridge marked (*d*) in Figs. 1 and 2, Plate I.

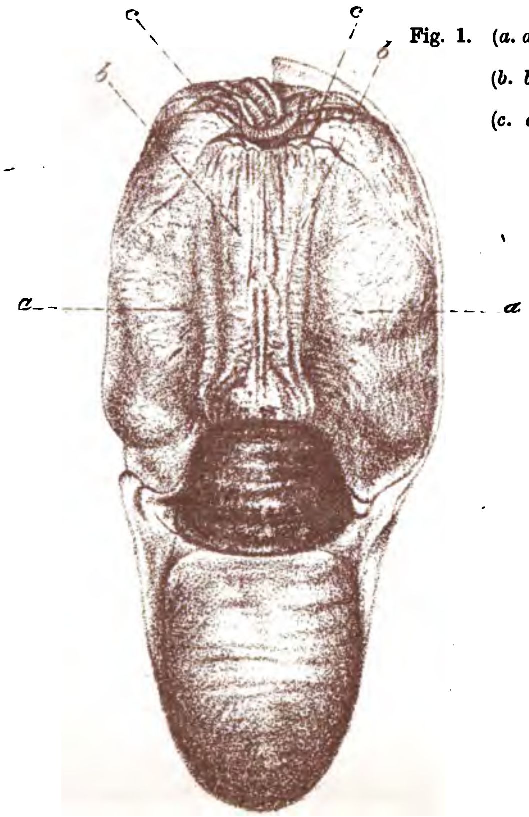

Fig 1.

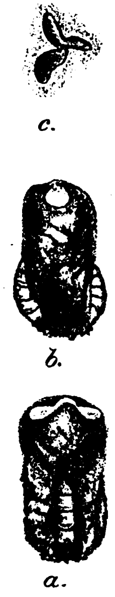

Fig 3.

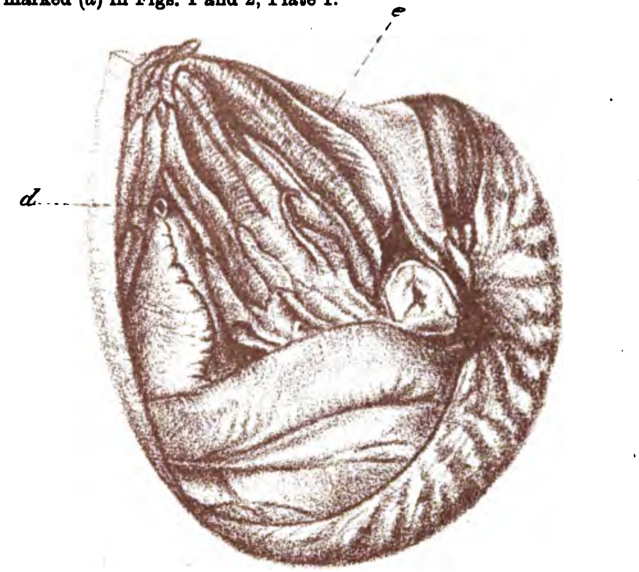

Fig 2.

J. Chartl, Delt.

The matrix which occupies the space supposed to have once been filled by the soft parts, is a very fine whitish marl, a mixture of lime and clay, softer than the grey clay of the ordinary external matrix. Much of this whitish marl may have been washed away during the years of exposure.

If, then, organs or coverings of the animal, at all analogous to the hood and mantle of the Nautilus, existed in the living Ammonite, it may reasonably be suggested that the *margins* of these organs or coverings might be of a much firmer texture than their middle portions; and, if so, that the margins would fossilise into a more durable substance. When, therefore, denudation took place, the marginal part might resist dissolution, and be left standing out as a prominent ridge, such as is seen in Plate I., Fig. I. (*b*), (*c*) and (*d*). The question next for consideration was whether the hood of the Nautilus would present anything like such a margin.

To answer this, with the concurrence and assistance of Mr. Moore and Dr. Herdman, it was resolved to remove a portion of the shell of a Nautilus containing the animal, so as to show the external appendages of the body. Further dissection was needless, because the Turvey Ammonite gave no indications of any internal structure wherewith to form a comparison.

Our Nautilus, thus displayed, gave full confirmation to the results of Professor Owen's researches. (*Memoir*, 1832). The funnel was seen close within the external convex wall of the shell. When the shell was first cut, the posterior fold of the mantle was visibly in contact with the involute portion of the shell, where, in many examples, the shell is coloured black. Notwithstanding the precautions used, a certain amount of shrinking occurred, and the mantle-fold disappeared below the hood.

The hood exhibits three portions, all of which are coriaceous—"of a fibrous texture resembling dense corium"—much thinner in some parts than in others. The three portions may be described as consisting of a central area and two side lobes.

The central area is oblong, about three-quarters of an inch in breadth, extending from back to front, where it slightly widens, and terminates in a flanged and slightly arched margin, immediately below which the tips of the tentacles appear.

The two side lobes slope to the right and left from the central area, and are somewhat triangular, narrowing towards the front; at first they entirely covered the eye, which was prominent, and is now, through shrinkage, entirely displayed. The lobes terminate below in a coriaceous margin, which is continuous with the frontal flanged margin of the central area, below which the tentacles appear.

The animal of Nautilus fossilised in soft clay, free from iron, and subsequently exposed to frequent washings, not improbably might show the course of the margin of the hood.

But it seems improbable that the animal of the Ammonite could withdraw itself so completely as the Nautilus within the shelter of its shell. Forms such as that of the well-known *Ammonites Jason,* and other variously-lobed terminations of the shelly part of the Ammonite, figured in the *Quarterly Journal* of the Geological Society, by Mr. Buckman, indicate that the body of the Ammonite needed protection or support, such as might be given by coriaceous margins of its external appendages. Whilst there is great difficulty in regarding the wavy ridge in Fig. 1 as a vestage of any portion of the shelly part, there is less difficulty in the suggestion that it may have been the margin of an appendage something like the hood in the Nautilus.

But in comparing Fig. 1 with Professor Owen's plate of the Nautilus (*Memoir,* 1832), it becomes plain that if the wavy ridge have any real significance of the kind which has been supposed, it shows that the body of the Ammonite occupied its shell, not as the Nautilus does, but with its ventral aspect next to the internal or concave wall of the shell. This seems especially to be indicated by the transverse portion of the ridge forming a kind of crest at (*d*), under which the tentacles might be looked for. If, on the other hand, (*d*) be on the extreme ventral aspect, some other mode of understanding the whole configuration of the wavy ridge must be adopted.

Investigators on the Continent have recently supported the view that the Ammonite may be more closely allied to Spirula than to Nautilus. The Turvey Ammonite seems to favour the conclusion that, in its position with reference to the shell, the Ammonite resembles the Spirula; but whether this carries with it a probability that the Ammonite was dibranchiate, is not obvious.

With the assistance of Dr. Herdman and Mr. Moore, two specimens exhibiting the soft parts of Spirula were examined. One of them was quite perfect. It had been brought to Liverpool by Capt. Whiteway, and presented to the Museum by Mr. F. P. Marrat, who was present during the whole of the examination.

The anterior termination of Spirula is shown in Plate 2, Fig. 3 (*c*). No prominent marginal lines marked the integument of the animal; but on looking closely in at the aperture, which had something of the form of a leech-bite, the mandibles, and apparently some of the tentacles, were seen deeply seated within. Doubtless they had been withdrawn by the retractor muscles. It did not seem to be of any use, in the present investigation, to proceed with examining the internal anatomy of Spirula, already the subject of a memoir by Professor Owen, and beautifully figured by him in the *Proceedings* of the Zoological Society for 1878, Plate lx., Fig. 4, and 1880, Plate xxxii. But some evidence respecting the comparative size of the shell and its constructor, in the Ammonite, had been before us, and we were satisfied as to the great improbability that the test of the Ammonite could ever have been an internal shell, in any such way as that of Spirula.

If, in the Nautilus, the lateral lobes of the hood have homologous relations with the valves of the Aptychus or Trigonellites in the Ammonite, then, clearly, one would expect to find in the hood of the Ammonite something differing greatly from the hood in the Nautilus. The side lobes of the Nautilus hood are appropriated to form the valves of the Aptychus, but the central area remains; and the point of chief interest in the Turvey Ammonite is the possibility that the central area at the vertex, commencing at (*a*), Plate I, Fig. 1, bounded on the nearer side by the wavy ridge, and terminating in the arched crest at (*d*), may bear homologous relation with the central, dorsal area of the Nautilus hood, terminating in front by the flanged margin arching over the tentacles.

Fig. 2, Plate I, which is taken from a photograph of the left side of the Turvey specimen, shows that the two sides differ considerably. The lateral shelly prominences continue much further, almost to the crest, and are more broken up than in Fig. 1; and there is no distinct appearance of a dark wavy line or ridge.

It may be conjectured that the fossilising matrix, in the form of fine mud, came upon the Turvey Ammonite lying on its right side. The mud would act as an antiseptic, and time would be given for the infiltration and replacement of the soft parts. The mud would not crush the central whorls of the shell divided into compartments, but would probably more or less break in the walls of the body cavity, causing great dislocation, and the disappearance from the upper side of characters which might be preserved on the lower side, as seen in Fig. 1.

The perfect plasticity of the matrix is well shown on the left side, where the clay has come clean away, like a cast from a mould, exhibiting the central whorl beautifully, though in diameter not exceeding the breadth of a pin's head.

There is a prevalent impression that the soft parts of animals do not fossilise, but there are all gradations in hardness, from the watery substance of a Jelly-fish, to the corneous stem of a *Sertularia* or a *Gorgonia*. Professor Owen speaks of the hood of the Nautilus as being "of a fibrous nature resembling dense corium," and of an Aptychus as preserved "in a simply corneous or chitinous condition." *Zoolog. Soc. Proc.*, 1878, p. 962. Fossilised remains of *Pennatulidae* and *Holothuroidea* are known, and even the impressions of *Medusæ* have been preserved in the lithographic state.

It only remains for me to notice certain other appendages of the Turvey specimen not yet described. In Plate I, Fig. 1, at (*f*), appears a shelly plate which can hardly fail to suggest the left valve of an Aptychus. Its structure, as seen under a powerful lens, is very peculiar. Its position renders it probable that it has been pressed over from the left side. It is clear that two such valves would not have filled the mouth of the shell, so that there would be need for the protection afforded by the coriaceous central area of the hood, the comparative development of which may possibly be a variable character amongst the many sub-divisions of the Ammonites.

The sutures are deep, much ramified, and sharply dentate. When the specimen was first found, their configuration was clearly traceable from the crop of a moss, *Weissia controversa*, growing in the sutures, and fruiting finely.

Just below the crest at (*d*) is a very small fragment, which may be the extreme tip of a tentacle.

Between "*a*" and "*b*" is a prominence which the photograph is wholly responsible for making so like an eye. It is much less so in the specimen, but is fairly in the right place for an eye.

On the vertex, and again at (*g*), is attached to the matrix an organic appendage, which may have been an egg-capsule. The egg pouches of *Cephalopoda* are not, I believe, clustered so closely as those of the Whelks; and if not, they might become attached singly to almost any part of the parent animal or its shell.

On the whole, it is, perhaps, not an unreasonable conjecture that the great and sudden change indicated near (*g*) occurred when the animal reached maturity, and assumed reproductive functions. That the broad lateral prominences extended alike on both sides, from (*g*) nearly or quite to (*d*), all or part of which formed the body cavity. That the pressure of the superincumbent clay came very gradually on the upper or left side, smashing the shell, which had nothing to support it but its own strength and the body of the animal; cracking also the right side of the shell, which rested upon the matrix, and came away in large pieces, and with comparatively little dislocation of the body-parts in contact with it.

I do not consider a single position in these notes as established. My observations are recorded with great diffidence, because in one or two points they differ from the conclusions of Professor Owen, without whose investigations I should have known simply nothing of the subject. I am happy in differing from one who can well afford to be indulgent.

NOTES ON RUNES.

By J. LINTON PALMER, F.S.A., Fleet Surgeon, R.N.

Before addressing my audience on the subject of Runes, I would state that their study is confessedly attended with some difficulty, not only on account of the variance of opinion between the best authorities, but from antagonism of so-called facts, and perhaps it would not be a waste of the time at our disposal to tell you first by whom Runes were made and used, and from whence those people came.

Once in a time of which we have no correct data, somewhere in the countries lying north of the Caucasus, between the Black and Caspian Seas, there was bred and nurtured a race of warriors, one of the most powerful in the list of conquerors. As it is estimated that about one-fourth of the inhabitants of our islands are descended from them, I think we have some little interest in the Norsemen and their goings on; so I begin with a rapid sketch of them.

This was their appearance, and even now their descendants resemble them:—Of fair complexion, with ruddy cheeks and blue eyes; hair reddish, often flaxen, smooth; brow high and broad; skull large and round; face oval. Of stalwart frame, with long legs and arms; feet and hands rather large; in stature tall, above the middle height. In disposition, they were sensual in animal pleasure, reckless of their own life, hence cruel and unsparing, with an enormous idea of independence; sincere; careless of danger, for this life to them was but strife and indulgence, and in that to come, of which they were assured there was to be only a repetition of this world's brawling and feasting. Why should they hesitate to expose themselves to chances of death. Nay, as "death on the straw"—stræðæd—was thought ignominious, they preferred a surer passage to their heaven by an axe blow or lance thrust, or should this not happen in combat, they ended their days in a way I shall advert to presently by cutting Runes to Othinn.

Their language was distinctly Aryan. Haxthausen says they are at present to be recognised in the Caucasian tribe of the Ossetes. They seem to have been much allied to the old Parthians and Sarmatians—not to the Slaves.

Scandinavia, or Scania, was considered by the old Greek and Roman navigators as a cluster of islands. Pythias of Marseilles, who lived circa B.C. 320, got up so far. He visited Albion, and came in six days thence to a country in the N.E. he calls Thule, probably Jutland or Thyland, in old Norse called Thjoda. He says the people of the north were hunters and fishers; those to the south grew grain, reared bees, and drank hydromel, but all were equally fierce. The old geographers and historians enumerate among the Scandinavians the Sviones (Sviar, of middle age, Norse). Guttonæ—Gutæ (Goths). The Danksiones or Danes, whose original seat was Scania (Danir or Danskir of old Norse). Procopius, in his sequel to Belisarius, accurately describes the Norsemen. It was from Jutland the Cimbri (Kimbr, a warrior) came down upon Rome B.C. 110. Tacitus gives great eulogy to this people, who, on emigrating from Asia, are said to have been led by Othinn, their Pontiff chief, and his subordinates the Œsir.

But there are certainly two Othinns. The first their High Deity—one of their Trinity, the three sons of Bör—he who to man gave life and spirit—at first called Alfadir, Allfather; but in later times he appears as Valfadir, the

Choosing Father, *i.e.*, of those to be slain in battle. His dwelling is Gladsheim, in Asagard, in which is Valhalla (the Hall of Choice). There the souls of the Einherjor—the select heroes—are received and waited on by the Valkyrjor, choosers of the slain, celestial virgins, Othinn's angels, so to say. Othinn and they feast on the wild boar—Sœhrimnir—quaff hydromel, and fight their battles over again till tired. Othinn, however, is to perish at Ragnarökr, he being only an emanation of the Alfadir, "who liveth from all ages, swayeth all things, great and small, hath formed heaven, earth, and all things thereto belonging, hath created man, and given him a soul that shall live and never perish, though the body be mouldered, or burnt to ashes."* The Pontiff chiefs, who governed these tribes despotically, both in "Church and State," seem to have assumed this title, Othinn, as their cognomen, as the Egyptian monarch's title was Pharaoh—the vicar of the Sun-god on earth.†

The particular Othinn of whom I speak is the legendary or historic Othinn, whose name was said to be Sigge, the son of Friddulph, and who owned many possessions in Tyrkland (Turkestan). He and the Sviar sallying forth, passed the Tanais, or Don, and settled for a time in Asgard, the Aspurg of Strabo—Azov of to-day. There he left his two brothers, and traversing through Gardariki (Russia), passed on to Saxland, and thence to Odensee, in the Isle of Fünen, staying there some time. He left his son, Skjold, in Denmark as regent, went on to Sweden, and lived at Old Sigtuna, on the Malar See, near Upsala, where he at last died, and was cremated, having first, to avoid "Strâdæd," given himself nine wounds in a circle with a lance-head, besides cutting his veins, to avoid "going to Hela." This is the Cutting Runes to Odin. In the Frithiofs Saga—King Ring's Death :—

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* *Prose Edda*, c. 3.

† If, as many say, Othinn means the sun, what a coincidence is this with Pharaoh, Phrah, the Sun God.

> "Now will I shed my blood. Bring me a sword ! 'Tis good
> To follow strict our old forefathers' law.
> The Northern kings disdain their bright renown to stain,
> Breathing their last ignobly on the straw.
> To Odin now each vein he cuts with placid mien,
> And Runes of blood his dauntless soul attest."

Othinn is represented as the most persuasive and eloquent of men, able, like Mahomet, to inspire his followers with utter contempt of evil chance, danger, or death ; also he was a poet, a Runeman, and said to have invented Runes ; he was regarded as a divinity.*

Edda Lore.

We now come to the traditions of this race, without which we should be in the dark as to the meaning of Runes. There are two compilations called Edda, one in verse, the other in prose. They say the meaning of the word is Great Grand Mother.†

The elder, or Poetic Edda, is the work of a celebrated Icelander, Sæmund, son of Sigfus, always styled the Wise, Multiscius, deeply learned, who lived at the close of the eleventh century, just after the legal establishment of Christianity in Iceland. He was a lineal descendant of King Harold Hildetön. He became priest, yet had the reputation of practising "white sorcery." It is said, though adequate proof is wanting, that he transcribed these poems from Runic staves or manuscripts yet, most probably, oral tradition was the source of his information.

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* He knew how to sing lays (his subordinate had the name of "Master of the Lay." He could strike his enemies with blindness, deafness, or sudden panic, and could assume any form that he wished for of beast, bird, or fish, meanwhile his body remaining in a trance.

† Some say it is derived from the feminine of oðr or odr—*wisdom*.

Bishop Brinjolf Sveinson, in 1673, caused a transcription of these poems to be made. They were found in a vellum codex, judged to have been written at the beginning of the fourteenth century. This codex is now in the Royal Library at Copenhagen. Amos Cottle, of Bristol, translated and published, 1797, the first part; which was subsequently done by Finn Magnusen, in 1828, and by Thorpe, in 1866. The poems of the Elder Edda may be divided into those of the mystical, didactic, mythologic, and heroic, or mytho-historical classes.

The Prose, or Younger Edda, is believed to have been the compilation made by Snorri Sturlason, who lived about a century after Sæmund. He was a most extraordinary man in all respects, who, after a turbulent life, was assassinated by his kindred in 1241, aged sixty-three.

In this is to be found a most complete synopsis of Norse mythology, and it is very probable that Snorri made use of the MSS. of Sæmund and Ari the Wise for the important parts of this work. These MSS. were preserved at Oddi, and we are ignorant of their precise contents. In 1818, Rask published a very correct edition of the original text.

This Edda was succeeded by a collection made by unknown authors, called the Skalda. This was a sort of dictionary of synonyms, such as that found in the Alvismâl, also an Ars Poetica, so to say, an essay on the art of versification. Rask, in 1818, translated it; but Resenius, by mistake, in 1665, incorporated half of it in Snorri's Edda.

The Skald was not so much a poet as a versifier, or verse-smith — "Ljoda-smith," as he was often called, though not as a term of reproach. The Edda is the production of sages and poets.

The Skald, too, was not only a roaming minstrel, but a herald or ambassador between hostile chiefs and tribes, having by this office a kind of sacred character attached to his vocation. He followed his chief to battle. Harold Harfäger had four principal skalds, with whom he even took counsel on matters of importance. Canute the Great had several at his court. Thormod, a skald of St. Olaf, dictated in one battle a lay still extant, which was chanted by all the warriors. Though mortally wounded by an arrow, he did not leave the king's side, but continued to chant his praises till he died; two other skalds having already been killed near the king. Hacon, at Jomsburg, had five principal skalds.

Pardon me, but it is requisite that I must next mention the Saga, so called from the Norse Goddess of History—the say, the narrative—a story in prose, with verse interspersed from time to time, inasmuch as any striking incident to move the feelings or excite the passions was versified—ordinary events running on in prose. These Sagas are, like all history, variously credible; so many were oral tradition before they were written. Many have so much mythos in them, that though they are untrustworthy, yet are most valuable, as giving us a gleam of light as to old habits, manners, prejudices, and cultus. Then there are the Romantic Sagas, also Historical Sagas, whose details bear the minutest investigation; Pedigree Sagas; Sagas of the lives, feuds, travels, and deaths of mighty chiefs, which rouse from apathy anyone of even ordinary perception. Let me instance that charming one of the Burnt Njal, or the Laxdæla Saga, which, like the Paston Letters, lets us into the idea of the house and all its goings on. That exaggeration, or even contradiction, occurs, is hardly to me an evidence of wilful deceit; very hard it is to be dispassionate. In fact, even now, if we take the narratives of any dozen spectators of any ordinary event, do we find that they correspond in every particular?

One of the best Sagamen was Ari Hin Fródi, A.D. 1066, the fellow-student of Sæmund. One of his works—the

Schædæ—is supposed to be the earliest document *written* in the Norse language, A.D. 1120; it tells of the leading events in Iceland from its colonisation to his own time.

RUNE.

I now come to the primary object of my Notes—Rune. What is a Rune, and why is it so called? This, I think, no one can say with certainty. Ryna means, in one dialect, finding out occult things, magical work; in the Gothic, mystery, consultation; in High German, mumbling, counselling, as if a kind of Delphic oracle.[*] Tacitus says that in certain groves a divinity—Alruna—was consulted, but only in undertone. The Brothers Grimm say its derivation is Alraun (au equals ü)—the mysterious dæmon supposed to animate the Mandragora—Mandrake of the Bible—the juice of its root inducing temporary delirium, and itself so noxious as to cause instant death to anyone who plucked it from the ground and heard its shrieks.[†] Sprigs of the Rowan tree—Mountain Ash—have for a long time been credited with power against witchcraft. But first, Rune means a song or poem; next a carmen or magical chant; next a scribed or engraved character, the visible representation of the foregoing—a letter, in fact—or *vice versa*, the letter; next the song—it is difficult to say which.

RUNE AS A POEM.

A poet is often called a Runeman, and the songs and ballads he made in popular verse, always in eight-lined strophes, with two, three, or four accentuated syllables in each line—Rúnhende.

RUNE AS AN INCANTATION SONG.

These were called Galdr or Runeslag, *i.e.*, Runestroke.[‡]

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[*] Faulman.

[†] See John's *Flowers of the Field*, p. 443.

[‡] See Danish Ballad, "Sir Thynné."

The inventor of these magic chants, as well as of the characters, is said to have been Othinn. It is narrated that he found them in use among the tribes which he and his followers dispossessed. But the magic of his chants proved the more powerful. He called his the Kingly Art, in contradistinction to the Black Art of his adversaries, and of the Lapps and Finns, which it overthrew. But, probably, in after times the two systems merged into one.

Now, these troll rúnar—magic runes—had a twofold use. The first, the helping or succouring; the latter, the noxious or bitter runes; the first to aid or to avert hidden danger from the user; the latter to act particularly against a foe by bringing him evil, sickness, or death. Of each sort five kinds were used. It seems evident that troll rúnar were in vogue before inscriptions to the same intent were scribed—songs anteceding book making.

These chants are particularly adverted to in the Havámal —the High One's lay—the canticle of canticles; in it is found Othinn's Rune Song. There, he says, he knows "I hung on a wind-rocked tree, to Othinn offered *myself to myself* . . . . to runes applied myself; wailing learnt them."

"Those songs I know, which the king's wife knows not nor son of man.
Help, the first is called, for that will help thee against strife and care.
For the second, I know what the sons of men require, who will as leeches live.
For the third, I know if I have great need to restrain my foes—
The weapon's edge I deaden of my adversaries, nor arms nor wiles harm aught.
For the fourth, I know if men place bond on my limbs, I so sing that I can walk.
For the seventh, I know if a lofty house I see
Blaze o'er its inmates; so furiously it shall not burn
That I cannot save it—That song can I sing."—κ.τ.λ.

And so he goes on. By another he can pacify hatred among men, lull storm and save from shipwreck, cause troll wives sporting in the air to assume their own forms; by another to cause the dead to revive, by graving character runes; by another, to render a man invulnerable by sprinkling water on him, while chanting; and, lastly, to excite the love of maidens, "and wholly turn their minds."

In another of the Edda poems—the Gróugaldr—the mother of a young man sings to him chants, teaching him the same power.

Next, the characters which are found scribed on rocks and stones, not only in Sweden and Norway, but in many other lands, are certainly of very remote antiquity and of Pagan origin. Androtion says "the Thracians and other barbarians do not make use of letters, which are commonly used by the Asiatics." Tacitus has a remark on this subject which I think is generally mistranslated. Strahlenberg says that in remote places of Tartary and Siberia there are rocks on which Runic characters are scribed, and if he and other travellers are to be credited, we may think that Rune had its origin somewhere in Asia, and was exported by the tribes issuing thence to the north-west of Europe. As to their authorship, Bartholin, quoting an old Lay, says, "The letters which the Gods composed." In the Voluspä, the recording of events is ascribed to the Norns, the Parcæ of the Norse Mythology.

If we look at a Rune, as a character, we find it to be like the cuneiform character of the Asyrian, or that of the Chinese, a scratch, rectilinear, just as would be best suited for cutting on stone or wood, no arcular figures or flourishes. Hence, if any resemblances are to be found in it to that of a sign of another nation, I think it would be rash to conclude that it is not primitive. Dr. Samuel Birch, whose letter I read, tells me that there is no known connection of cuneiform writing with Rune. Stephens, a very high authority on Rune, also says that it is not borrowed from the Phœnician, but is a class of itself. In Archaic Greek,* as in Rune, there are but sixteen characters, and the B, L, and R are identical in form and sound with the Rune. In the Iberian, Etruscan, Umbrian, and others, some forms are similar, but the sound-power is different. Even in the Himyaritic character, so well studied by Colonel Prideaux, and figured in the plates on the table, † the sound is not that of the corresponding sign.

There is one circumstance, perhaps conclusive, to show that Rune is really primitive, the sequence of its character.

In the Semitic language, Greek, Roman, and Etruscan the sequence is A, B, $\frac{G}{C}$, D.

In the Himyaritic, it is A, B, G, L, N.

But in the old Norse Rune, it is F, U, Th, O, R, K.

In the Ogham, a descent of the Phœnician, it is very different.

The Himyaritic I refer to is found in many slab-inscriptions, near Aden, in Arabia. Colonel Playfair is the best authority on the subject.

As in old Greek, so in Rune, originally there are but sixteen characters; and one authority—Faulman—who has written very ably on the origin of writing, says, " In the very oldest *Futhork* there are but fifteen characters—F, U, Th, R, K, H, N, I, A, S, T, B, L, M, Y, in sequence.

I somehow think that the mighty Runes, each of which had some occult power, were these primal Runes. For subsequent to these very old Norse Runes, other characters have been added. The older the Rune is, the more clearly it is scribed, and the inscriptions are found in Scandinavia and Great Britain. Rhabanus Maurus, Archbishop of Mainz, ninth century, A.D., gives us the German Runes, used by the

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[*] Gesenius.

[†] *Trans. Bibl. Archæol.*, vol. iv., pt. 1st.

RUNES.

OLD NORSE.			SCANIAN.		ANGLO-SAXON.			GERMAN.	BRACTEATE.	
Word.	Letter	Sign.	Letter.	Sign.	Word.	Letter.	Sign.	Sign.	Word.	Sign.
FÉ ...	f	ᚠ	f	ᚠ	feoh	f	ᚠ	ᚠ	fé	ᚠ
ÚR ...	u v	ᚢ	u	ᚢ	ûr	u	ᚢ Λ	h	uraz	ᚢ
THURS.	þ ð	ᚦ	ð	ᚦ	ðorn	þ	ᚦ	ᚦ ᚹ	daaz	ᚦ
ÓS ...	o	ᚬ	o	ᚬ ᚭ ᚨ	ôs	o	ᚩ	ᚨ ᚩ	aza	ᚨ
REIÐ..	r	ᚱ	r	ᚱ	râð	r	ᚱ	ᚱ	rœda	ᚱ
KAUN..	g k	ᚴ	g. k.	ᚴ	cên	c k	ᚳ ᚳ ᚳ	ᚳ ᛇ?	chozma	ᚲ
			g	ᚵ	gyfu	g	ᚷ	✳	genua	ᚷ
			v	ᚠ	vên vyn	v	ᚹ		uinne	ᚹ
HAGL..	h	ᚼ	h	ᚼ	hägl	h	ᚺ ᚻ ᚽ	ᚻ	häal	ᚺ
NAUÐ..	n	ᚿ	n	ᚿ ᚾ	nead	n	ᚾ	ᚾ	noicz	ᚾ
IS......	i	ᛁ	i	ᛁ	îs	i	ᛁ	ᛁ	üz. iiz	ᛁ
AR ...	a	ᛅ	a	ᛅ ᛆ	gêr	ge. j	ᛄ ᛄ	ᛄ ᛃ	gaar	ᛃ
					eóh	eo	ᛇ ᛇ	Y	quertza	ᛇ
			p ?	ᛒ	peorð	p	ᛈ	ᛈ	pertra	ᛈ
					eolh	?	ᛉ	ᛋ ᛋ	uncior	ᛉ
SÓL ...	s	ᛋ	s	ᛋ	sigel	s	ᛋ	ᛏ	sugil	ᛊ
TYR ...	t	ᛏ	d. t.	ᛏ ᛐ	tir	t	ᛏ	ᛒ	tyz	ᛏ
BJÖRK.	p b	ᛒ	b. p.	ᛒ	beorc	b	ᛒ	ᛖ	bercna	ᛒ
			e	✝	ehu	e	ᛖ	ᛗ	eyz	ᛖ
MADR..	m	ᛘ	m	ᛘ	man	m	ᛗ ᛗ	ᛚ	manna	ᛗ
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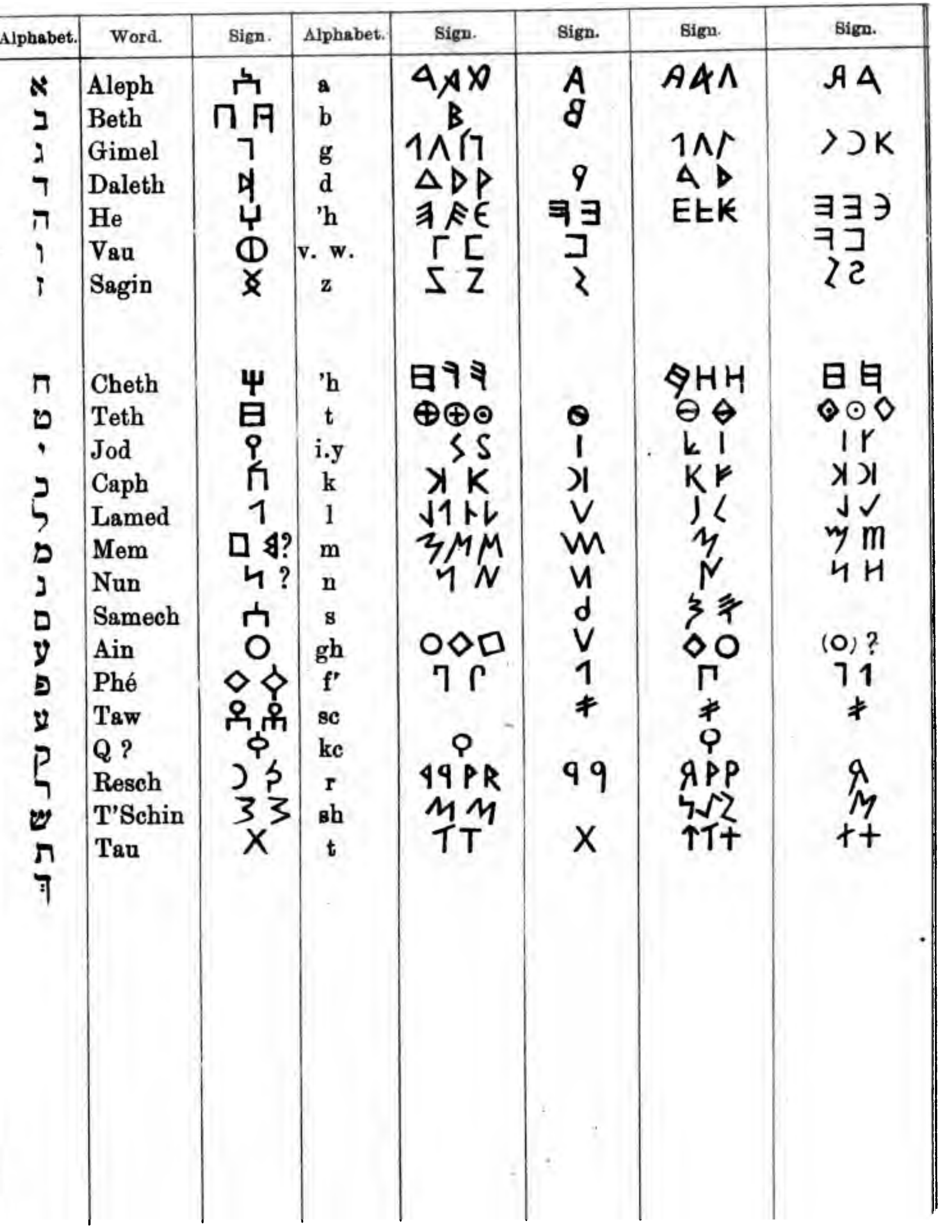
RUNES.



HEBREW. Alphabet.	HEBREW. Word.	ENGLISH. Alphabet.
א	Aleph	a
ב	Beth	b
ג	Gimel	g
ד	Daleth	d
ה	He	'h
ו	Vau	v. w.
ז	Sagin	z
ח	Cheth	'h
ט	Teth	t
י	Jod	i.y
כ	Caph	k
ל	Lamed	l
מ	Mem	m
נ	Nun	n
ס	Samech	s
ע	Ain	gh
פ	Phé	f'
צ	Taw	sc
ק	Q ?	kc
ר	Resch	r
ש	T'Schin	sh
ת	Tau	t
ךּ		

Marcomanni for sorcery. In a vellum codex, at St. Gallen, about 900 A.D., there is another set of Runes, reduced to the a, b, c, d sequence. The Anglo-Saxon Runes, too, found inscribed on many monuments in England, are more numerous than old Norse; they amount to even twenty-four characters in one catalogue (St. Gallen), and the same number is found stamped on the Bracteates. On a knife-blade, found in the Thames, there are twenty-eight characters, and in a skin-book, now in the library of Cheapinghaven, thirty-three are found. I do not speak of the Gothic characters in the Gospels of Bishop Ulphilas; they are modifications and additions for easiness in writing or printing; and I think the Anglo-Saxon Rune owes its number to the same source. A Bishop of Poictiers—Venantius Fortunatus—says he will write to his friend in Rune—not Norse, but German Rune. He uses the words "fraxineis tabellis," possibly not *ash*, hard to carve on, but Rowan tree, an even-grained wood.

COMBINATION.

Not only were these old Runes increased in number, but combined; these are called "Bind Runes."

Also, there is a variety called Crypt Rune—a sort of cipher, used for correspondence. When his sons-in-law and stepson had determined to kill Snorri Sturlason, he was warned of the plot by a letter in Crypt Rune, sent from his friend Osbjornson. Although one of the most learned men of his day in this literature, he failed to discover its meaning, and succumbed to his fate. There is, or was, in the library of Lord Tollemache, in Cheshire, a skin-book, A.D. 920, written in this character.

The Rune was used as a numeral, as Sir J. A. Picton has told us; also, to indicate the cardinal points of the compass. The very oldest reads, F, Th, U, O—N, S, E, W;

afterwards we find some alterations. Here are two—F, R, Th, H, and U, K, O, N.

TIME.

The old Norse Rune was used as a measure of time. For daily use, the twenty-four hours were divided into parts of three hours each, commencing at midnight; each part was shown by a sign of the Futhork in its sequence; in later times, the parts were of half the original length. For the year, which began at midnight 25th December—Yule—the calendar was divided into four sections:—

Dec. 25, part	1st,	days	23 ...	22 ...	23 ...	22
	2nd	,,	23 ...	22 ...	23 ...	24
	3rd	,,	23 ...	22 ...	23 ...	24
	4th	,,	23 ..	22 ...	23 ...	23 Yule.

A sign of the Futhork was put at the beginning of each division. These were inscribed on calendars, called Rimstocks and Primstaves. It is surmised they are of Pagan origin, inasmuch as they were in Rune, and no one hitherto has exhaustively examined the subject. Of those now remaining, none are before the fourteenth century, and in these the Rune is mostly replaced by other signs. Stephens says they vary much in material and form. One splendid example is an oblong wooden ring or collar. Bone, metal, and ivory were used, but usually wood, in the form of squared sticks, are Clog almanacs. Long staves, round or flattened, like swords without guards, Prim staves; which were bored through the pommel to be hung up by; or flat tablets of wood; exceptionally of parchment or paper. In the clog the angles were notched and the signs scribed on the sides. Many of these have been preserved. The most noted are the Finch and Moss Clogs, oak, at Manchester, A.D. 1586; Bradbury, oak, same time; Camden, Litchfield Clogs, oak; and some others of the Primstaff; there are two on the table, and they are not uncommon, but all of recent date. This form is still used in Sweden, but the Rune has been changed for other marks. The Rune also in English specimens died out sooner than in the Swedish.

The Tablet or Bak Staff. There is one fine specimen of nine leaves of boxwood, in a case; the leaves are bored, so as to put a string through for arrangement. Each has three lines of marks; first, for saint and feast days, next for the solar, then for the lunar cycle.

CHARACTER RUNES—TROLL OR MAGIC—NITHING.*

These characters, when used for magic, were under the same conditions as the Magic Chant, divided into Helping and Bitter Runes. (See Wormius and Bartholinus.) Saxo Grammaticus says they were scribed on wooden tablets, and on weapons themselves. For medicinal helps, antidotes, or against melancholy, they were scratched on leaves or bark. The Love Rune was a dangerous † one to meddle with, for to err in the smallest stroke would bring illness to the beloved one, which could be cured only by better written Runes. These Runes were also inscribed on amulets; but perhaps the most remarkable of the Bitter Rune inscription was that on the Nithing post. Nithing was the most insulting and degrading epithet which could be applied to any one. William Rufus, having occasion to call out the Crown vassals while levying some force, sent a message to them to the effect that he who did not present himself should be held

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* Troll runor, divided into Skäderunon *mischief;* and Hjolprunor, *help*, five of each. See Verelius' Notes to Hervarar Saga, ch. 7.

† *Legend of Sir Thynné*—It was Thora, the Little Dwarf's wife—the five rune books she took, and so she loosed him fully out of the Runes, her daughter had bound about.

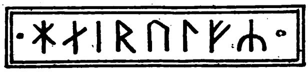
Nithing. Need it be said the levy was well attended, not a soul daring to absent himself. To intensify its meaning against an adversary, it was usual to erect a Nithing stake, or post—a common hazel-stick put into the ground with the utterance of an opprobrious epithet sufficed—but other practices were used to make the ills done to those who put it up recoil on the doers of them; a pole with a horse's head upon it being a post of especial efficacy.

NITHING POST.

Thus we find in the Egill's Saga, A.D. 937, that on Egill being banished from Norway—"Before he sailed he took one of the oars of the ship, upon which he stuck a mare's head, and, raising it, turned landward, and shouted, 'I hereby raise this rod of vengeance, and direct this curse against King Eirik and Queen Gunhilda; and the tutelary deities of this land, may they find no rest till they have expelled Eirik and Gunhilda.'" He then graved this curse on the blade of the oar, fixed it in the cleft of a rock, and left it standing.

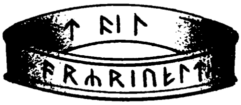
A like proceeding is told of in the Vatusdæla Saga, where a man—Jökul—fashioned a rude human head of wood, stuck it on a post on which he had cut magic runes. He then killed a mare, opened her breast, and stuck the pole in it, with the head turned towards his foe's dwelling.

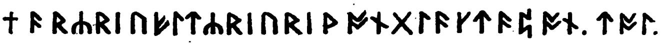
For inscription or writing, the ordinary arrangement of Rune is from left to right. When they run from right to left they are called Wend Runor. This occurs frequently on weapons, amulets, and bracteates; and, in addition to this, the form of the sign is reversed, as in Intaglio. Frequently they are written thus:—Beginning at the right, they run from top to bottom, then the next line is from bottom to top. Or again, like the Greek Βουστροφηδὸν, first line from



HAIRULFÜ

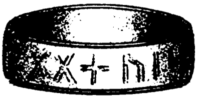
Inscription on a Gravestone at Oster Lygom, in Jutland. The man's name.

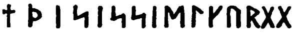




† ærüriufltüriurithonglæstæpon. tol.

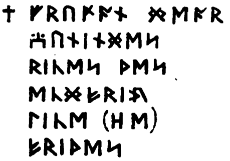
Norse Amulet Ring, found 1817, two-and-a-half miles from Carlisle; weight, 352 grains, gold. Three or four rings, with the same characters, have been found at Bramham Moor. They cannot be translated, for the simple reason they are Cabalistic gibberish.





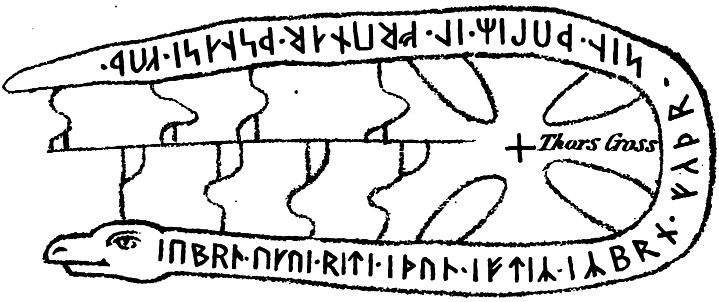
† thisissiælfurn.

A Leaden Ring, found at Coquet Island, near Lindisfarne; its date, *circa* A.D. 800–900; it was on a skeleton's finger. Its inscription :—"This is silver."

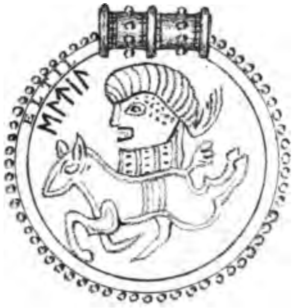


† FRUMAN GÆAR;
KUNINGES;
RICÆS THÆS;
EICFRITHU;
LICE (HE);
FRITHÆS.

Part of the inscription on the Bewcastle Stone. Meaning—In the first year of the King of this Realm, Eicfrithu,(A.D. 670.) Lie he in peace.

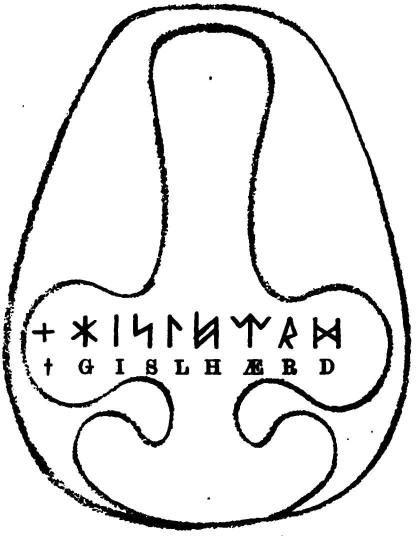


Gravestone in Upland, Sweden. Inscription: Jubern Ukvi, in memory of his father Irbern, inscribed (?) this stone with holy runes to As (Oðinn) God.



A Bracteate, silver. A Tooth-fee for "Baby." The figure, on almost all of them is a horse at full speed, with a man's head on the saddle. The runes before the face. Often in reverse order, as in the present instance.

End of an Arrow Shaft, with inscription in reverse order—Lu owns (this).



On a Gravestone at Dover. The man's name. The cross on this and No. 4 show they were made after the introduction of Christianity.

left to right, the next from right to left—ploughman's fashion. Of course the language of the Rune is that of the nation which used it. The old Rune is in the "Norræna Tunga," the Northern tongue, still spoken in Iceland.

INSCRIBED STONES.

Runic inscriptions on open-air rocks are very rare. In Sweden not more than half-a-dozen or so exist. But one is known to exist, or to have existed, near Barnspike, in Cumberland. The Runes deciphered mean, "Baran scribed this in memory of Gilles Buath, slain in truce, by Robert d. Vaux, for his patrimony, now called Laner-kaster (Laner-cost)."

Of stones inscribed there is a multitude, both in Great Britain and Sweden. Sir James Simpson has written much about one Cat (Battle) Stone at Kirk Liston, Edinburgh. As grave epitaphs they are found even at Dover. In Carlisle Cathedral may be seen the slab in the transept wall, discovered in 1856; it is scribed with Runes, which mean, "Tolfinæ scribed these Runes." Tolfin, or Dolphin, was Governor of Carlisle, circa 1092.

An inscribed stone of the greatest historic interest is the Kingiktorsoak Stone, in West Greenland, found on an island there in 1824. On it was a Rune inscription which, given to the separate judgment of the three best experts, Rask, Finn Meygnussen, and Bryjolfron, says:—"Erling Sighvatson, and Bjarni Thordasson, and Endrid Oddson, on Saturday before Gagn dag, raised these marks and cleared the ground, 1135."

Gagn dag—victory day—is either 14th May or 25th April. On it the people walked in procession. The three days before Ascension Day were called, in Anglo-Saxon, Gagn dagr—in old Scotch, Gang dayis. Other Rune scribed, but only on tombstones, are found in Greenland.

Crosses.

These are numerous enough in Great Britain, though mostly imperfect. The most famous is the Ruthwell Cross, near Annan, in Dumfriesshire. In Pennant's time it was twenty feet high, now but seventeen feet six inches, as it is mutilated. It is scribed over with Runes, part of the "Holy Rood or Dream," written by Cædmon, the Anglo-Saxon Milton. On its shaft is put—"Cædmon me made"—the poem, that is. It is notable for this circumstance. Some fifty years since, at Vercelli, in Italy, there was found a skin-book in Rune-character. Its contents were homilies and six poems. To Mr. Thorpe was entrusted the care of translating them. In 1842, Mr. Kemble was struck with the name of one poem—"The Holy Rood"—and, comparing, he found it identical with the scribings on this cross, which some years before he had deciphered. This poem has 314 lines.

You see in the pamphlet before you the cross at Gosforth, Cumberland, not later than the seventh century, said by Stephens to be the most elegant olden Rood in Europe. It is not scribed with Runes. Elsewhere, and in the Isle of Man, are crosses and scribed stones, written about, and with plates, by Rev. G. Cumming, 1857.

The Bewcastle Stone, twenty miles south-east of Carlisle, close by the Church, was twenty feet high, and surmounted by a cross fixed in a socket, still visible, a four-square pillar most exquisitely covered with carvings and Runes. On one side is scribed:—

"This spiring sign Pillar
Set was by Hwætard
Worthgar Olufworth
After Alcfrith, sometime King
and son of Oswi.
Pray for his soul's great sin."

Other scribings lead to the date of its erection, A.D. 670.

Bracteates.

These are stamped and engraved gold pieces, which have been much contested about, as they appear to be coins, to which, at the edge, a short tube-ring was fixed, so that they could be worn as pendants or lockets. No one seems to know when or how they were made. Almost all have Runes.

In class they are—

	A.D.	
Foreign	850–700	6 now exist.
Made in Scania	450–800	50 „ „
Foreign	1000–1100	2 only.

The characters are those of the old Norse Rune of the early Iron age—(Stephens). Yet in the Bracteate Futhork twenty-four signs are found—(Faulman). As a rule, on one side is a grotesque representation of a horse, at full speed, his legs contorted, a man's face only occupying the saddle, and opposite the forehead the Runes, usually reversed. Bracteates without Runes have been found in England. A large hoard was found in the Isle of Thanet, in 1865. Their evident use was—as amulet, battle medal, love token, and first-tooth gifts. Rings also, Rune inscribed, are not unfrequent; gold, and even lead, coins, Rune inscribed, have been found in England, dating from A.D. 600 to 800, and one was found in Holland, on the obverse, "Sacul on Au"—the moneyer's name—on the reverse, "Ecgberth," the great King of the Wessex, the Bretwalda. It is of silver, its weight twelve grains troy.

THE SCIENCE OF ÆSTHETICS.

By H. LONGUET HIGGINS.

I.—The Relations of Æsthetics to Science and Art.

In that dusky Debateable Land of Speculative Philosophy which lies beyond the boundaries of the Sciences and the Arts, and whose pathways soon lead us into the darkness of the unknown, there has arisen in modern times a province of knowledge to which the name of Æsthetics has been given. The word itself is from the Greek *αἰσθητικός*, anything perceived by the senses, *αἰσθανεσθαι*, to perceive; and its limitation to the perceptions of Beauty was made by the German philosopher Baumgarten, about the year 1750. Whewell * suggested *Callæsthetics* as a more accurate term, but it has not found favour. The definitions of the province of Æsthetics vary considerably, from the somewhat narrow one of Mr. Ruskin † to the wider and truer one of Professor Colvin, who defines Æsthetics as "a scientific doctrine or account of Beauty in Nature and Art, and of the faculties for enjoying and for originating Beauty which exist in Man." Yet even this might be extended, for Mr. Darwin has shown how large a part in Natural Selection has been played by the appreciation of beauty by individuals in the humbler ranks of animal life.‡

It is now admitted that every art rests upon a physical basis of science; *e.g.*, since the wonderful researches of Helmholtz, it is almost impossible to draw the line where Music melts into Mathematics. Yet though Æsthetics undoubtedly rests, like the fine arts of which it claims to be the philosophy or theory, upon a solid foundation of science, its claims to rank as a branch of science itself are by no means admitted. The boundaries of science are every day growing wider. It is but twenty-three years since Max Müller first lectured on the then new "Science of Language," and only since that time we have seen the scientific or comparative Method extended, and with the utmost success, to the kindred study of Mythology, with all its attendant train of folk-lore, fables, fairy tales and nursery legends; and even to the great Religions of the world. The wonderful growth and expansion of the modern idea of Evolution has made its mark even upon the study of Moral Philosophy; the Utilitarian theory is already said to be growing old-fashioned, and giving place to what may be termed Scientific or Evolutionary Ethics, of which, as might have been expected, Mr. Herbert Spencer is the chief apostle.*

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* *Philosophy of the Inductive Sciences*, vol. i., cxx.

† *Aratra Pentelici*, Lecture 1. ‡ *Origin of Species*, 161, 414.

The question now arises—Can there be a science of Art itself? Men have naturally been unwilling to allow the clear daylight of Science to penetrate into the ancient and mysterious realms of Art and Beauty. Nor can we wonder when we realise in what an atmosphere of Art we live and breathe. It colours most of our thoughts and reflections, and, as it includes Literature, how little but for Art should we know of the varied aspects of human life and thought! We may indeed almost fancy that we live in a glorious cathedral in which the white light of Truth has been chastened and softened by passing through the lovely stained windows of human feeling and emotions, which cast their varied hues over history, morals, philosophy, and religion, and tinge to some extent even Science itself. And let us not suppose that Science is naturally opposed to Poetry and Beauty. Were it not for Science, our dull senses would be blind to half the wondrous beauty which surrounds us everywhere, even in the everyday words we use, though here it has become obscured by the finger of Time.

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* See his *Data of Ethics*, 1879; and, for an interesting sketch of the progress of recent ethical theories in England, an article in the *Edinburgh Review* for April, 1883.

In considering the question whether Æsthetics has any claim to the title of a Science, it is as well to note first what it is that constitutes any branch of knowledge a science. Professor Huxley has lately told us that no line can be drawn between common knowledge and scientific knowledge. In strictness, he says, all *accurate* knowledge is science, and all exact reasoning is scientific reasoning.* The difference is, therefore, not one of kind, but of degree only. Secondly, we find a noteworthy and remarkably analogous case to that of Æsthetics afforded us by the new Science of Ethics. This science assumes that there is an ultimate ideal end and aim of conduct. "No school," says Mr. Spencer, "can avoid taking for the ultimate moral aim a desirable state of feeling, called by whatever name—gratification, enjoyment, happiness." † And he divides Ethic Science into (1) *absolute* ethics, or the law of perfect right in human conduct, and (2) *relative* ethics, which, recognising wrong in human conduct, has to decide in what way the wrong deviates from the right, and how the right is to be most nearly approached.‡

So Mr. James Sully, in his interesting essay "On the Possibility of a Science of Æsthetics," § holds that there can be such a science, because art is controlled by an *ideal end*, viz., the highest quantity and quality of human pleasure, ‖ and because the science assumes that there is a discoverable progress in all mental development, including a capacity for æsthetic and other pleasures.* "How the sense of beauty in its simplest form—that is, the reception of a peculiar kind of pleasure from certain colours, forms, and sounds—was first developed in the mind of man and of the lower animals is a very obscure subject;" † but æsthetic impressions "are peculiarly susceptible of development by appropriate culture, under the influence of which they not merely grow up in the individual, but manifest themselves with increased vigour and more extended range in successive generations."‡

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* *Introductory Science Primer.*

† *Data of Ethics*, p. 46.

‡ *Ib.*, pp. 275, 277.

§ *Sensation and Intuition*, p. 336.

‖ *Ib.*, p. 349.

The chief difficulty in the case of the two sciences based upon ideals, Ethics and Æsthetics, is to establish a satisfactory criterion or standard of what is, in the one case, to be considered right or wrong, and in the other, beautiful or the reverse. And, from a scientific point of view, the best answer that would seem possible to this crucial and deeply interesting question, is that the criterion or standard in each case must consist in the nearest attainable approach to the ideal which, as we have seen, each of the two sciences sets before itself. This criterion or standard would seem to answer to the *verifiable element* which, Mr. Lewes tells us, distinguishes science from speculative philosophy, vigilant verification being the safeguard of science.§ And it would be no objection that the criterions or standards of right and wrong and of beauty vary from age to age, and in different countries, according to the measure of civilisation attained to by each particular community. For the theory of Evolution assumes, not only that this would be and always has been the case, with regard to morals and art, but that religion and law themselves, as well as the fine arts, necessarily conform to the general conditions under which they flourish or decline in any given age and country—conditions of race, climate, civilisation, and manners.

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* *Sensation and Intuition*, p. 353.

† Darwin, *Origin of Species*, p. 162, and see p. 414.

‡ Carpenter, *Mental Physiology*, 6th edit., p. 210.

§ *History of Philosophy*, vol. i., Introduction, p. xl.

Like the Science of Ethics, the Science of Æsthetics will be a department of Mental Science, and will rest partly on abstract psychology, which deals with the faculties and emotions without reference to their historical development, and partly on historical and concrete psychology, which latter traces such development, and thus in its turn forms a department of anthropology, or the science of human development in general. Again, like the Science of Ethics, the Science of Æsthetics will, in addition to its theoretical side, have a preceptive or practical side. And as it is this latter side which will probably be the more useful, by serving as a steady light to the faltering and uncertain steps of Art-criticism, it is proposed to devote the latter part of this paper to a brief glance at some of the principal modern art-theories with which the science will deal, and upon which, it is to be hoped, it will throw some light.

First, however, as it will, as we have seen, be based to some extent on Art-history, let us glance at the historical aspect of Art as a whole, and see how the most civilised nations of Europe have regarded Art and Beauty, and their relation to Life and Goodness.

II. Ancient and Modern Views of Æsthetics.

(*a*) *Ancient.* It is very noteworthy that the Greeks, who excelled in the perception and cultivation of the Beautiful, never separated any group of arts and called them "fine." Nor indeed was there any need so to do, for they never separated Art and Beauty from their natural connection with and helpfulness to Life and Use. Art fulfils her noblest function in being a handmaiden to Life; and so do Science and Philosophy, if we would but rightly regard them. As regards the ethical or moral view of Beauty taken by the Greeks, some of their wisest philosophers dimly taught the unity of the Beautiful with the Good or Useful, and they laid stress on the æsthetic rather than the ethical aspect of virtue.*

(*b*) *Mediæval.* Next came the reign of Christian mediævalism, during which long dark period Art may almost be said to have slept a magic sleep, like the sleep of the lovely maiden Brynhild of the Northern legend, wounded by the thorn of Winter. For what was the result of the theological teaching of the necessary connection of matter with evil? It necessarily followed that, so far from human beauty being admired, the passions and beauty of the body were universally regarded as the most deadly of temptations. The philosopher Plotinus was so ashamed of having a body, that he refused to have his portrait painted. Hence arose the ascetic or mediæval ideal of life, one of the fundamental errors of which was the supposed necessary separation of beauty from goodness and rectitude. As Art has ever been the mirror of human life, the prevailing religious ideas were faithfully reflected in it, and instead of Beauty being the ideal of Art, an ascetic and conventional ideal of *ugliness* was supreme for ages in Art, particularly between the sixth and twelfth centuries. I need only refer you to many of the Roman mosaics of that period, and to Mr. Lecky's comments upon them.†

(*c*) *Modern.* Lastly, we have the modern revival of Beauty, which dates from the close of the fifteenth century. This arose partly from the revival of classical learning, partly from the gradual secularisation of Art, and partly from the new social and useful views of human life, as opposed to the selfish, slothful mediæval or ascetic ideal. For the warm current of human feeling for Beauty had never ceased to flow, though frozen over during the long winter of ecclesiastical mediævalism. Gradually, at the close of the intellectual glacial period, the icy fetters of religious conventionality melted away before the warm spring winds of healthy views of Life and Beauty, and Art again put forth her tender blossoms in the genial climate of the epoch in which we still live. Yet the final re-union of Art and Use hardly began till the present century, and we may hopefully look forward to a time when Fine Art and daily life and use shall again be as inseparable as they were in ancient Greece.

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* For a brief epitome of the chief ancient and modern theories of the Beautiful, see Bain's *Mental and Moral Science.*

† Lecky, *History of Rationalism*, i., 230.

III.—Modern Art Questions.

(1) *National and Universal Art.* A remarkable theory was put forward by Goethe, viz., that the days of nationality in literature are numbered, and that the glorious era of an universal or world-literature is at hand. The same idea is seen in the recent opposition to the foundation of an English College of Music, on the ground that it would tend to the formation of a "national" school of composition. This theory has apparently sprung from that modern scientific spirit which tends to throw down all the ancient landmarks, to destroy the importance and interest of individuality, and to make human life and knowledge as uniform and *colourless* as possible. If we love art and literature, let us beware of colourlessness, for in them, as in social life, the interest of individuality or personality is a principal charm; and nationality is but an extended personality. Science is the only branch of knowledge which is (or ought to be) absolutely cosmopolitan and colourless, untinged by the prismatic colours of human feelings and emotions.

(2) *The Province of Fine Art.* The Science of Æsthetics should not only enable us to correctly classify the various Arts, but should also give us a clearer notion of what should be properly included under the term *Fine Arts.* This is a modern appellation which has been given to a very limited number of them. When we speak of the Fine Arts, we generally exclude even poetry and music, and signify painting, sculpture and architecture alone. Now the exclusiveness of this class-word has probably had almost as evil an effect on Art as the narrowness of the term "classical" has had not only on Art, but on the study of ancient languages, literatures and archæology, confining such studies to the case of two or three favoured nations at most. We shall soon, it is to be hoped, look with more just appreciation upon those lowly arts which have sprung up like modest violets at the feet of the greater arts, and lived in their shadow. And then we shall acknowledge that in whatever art the spirit of beauty dwells, that is, "in which the heart of man works in sympathy with his hand and his head," that art, be it ever so lowly, is a true Fine Art, which simply means a refined or beautiful Art.

(3) *Truth to Nature.* The great question which perhaps of all others divides the modern art-world into two great camps is whether the end of Art is absolute truth to Nature, or whether the artist may refine and idealise the beauty of Nature by a process of artistic selection of her best features strangely analogous to that process of Natural Selection whereby Nature secures the survival of the fittest. It is difficult to treat the subject with reference to Art in general, because imitation enters in such different degrees into the various arts, being most conspicuous in Sculpture and Painting, and least so in Music and Architecture. Let us take Painting. The German Preraphaelite movement at the beginning of this century was a reaction in favour of

absolute truth to Nature, even at the expense of Beauty; and so was the English Preraphaelite movement of thirty years ago; but the English movement differed from the German in not possessing the strongly religious character of the latter. It is commonly supposed that the so-called Æsthetic School is really, as it certainly is apparently, a direct descendant of the Preraphaelite. But the fundamental principles of the two are so opposed, that we must refer the true artistic original of the Æsthetic School, both in Poetry and Painting, to the school of Artistic Beauty-worshippers, headed by Keats, and diametrically opposed to the Natural Beauty-worshippers, of whom Wordsworth is, of course, the chief representative. The Æsthetic School is very interesting for two reasons. First, because it is the inevitably found extreme party which carries the principles of a great intellectual movement to an undue length, the movement in this case being the great revival of the love of Beauty in England. It has a counterpart at the present day in the so-called Ritualistic party in the National Church, which party is noted for having carried to its farthest limits the movement in favour of increased beauty in church building and church ritual. This ecclesiastical movement is itself but a part of the great national revival of a desire for Beauty. In the past we need only refer to the parallel cases of the coterie of the Precieuses in France (ridiculed by Molière in his day just as the "Æsthetes" have recently been by Gilbert and Sullivan), the Gongorists in Spain, the Marinists in Italy, and the Euphuists of our own Elizabethan days. All these carried the taste for beauty over the verge of affectation.

Secondly, the Æsthetic School is interesting as evincing the inevitable looking back to the past in which constitutes the essence of every revival or renaissance of art or learning. Hence its affectation of Mediævalism, which cannot but be an anachronism, and therefore an artistic mistake. For the tone of thought and views of life which produced mediæval art are gone, probably for ever. Surely Art has no need, any more than Science, to fear the future. Yet let us be just to "æsthetic" Painting. It has a conventional beauty and peculiar charm of its own, arising, like that of its Oriental counterpart, Japanese Art, not from its truth to Nature, but mainly from an exceedingly marked *individuality.* For the sake of this we forgive, in the West, the unhealthy looks of Mr. Burne Jones' youths and maidens, and in the East, the curious want of perspective in Japanese Art. Æsthetic poetry, of which we may take the late Mr. D. G. Rossetti's works as a type, has also a marked individuality and many peculiar beauties of its own. The unwholesome and morbid tendencies of many portions of it arise partly from a too exclusive devotion to what is considered to be the ideal of artistic beauty, at the expense of Truth and healthy open-air feeling. In defence, we are informed that "we must love Art for Art's own sake;" indeed, this is the æsthetic law and prophets. But a high and wise authority has said that all great art is praise of something we love, and that we shall never love Art well till we love what she mirrors better.*

(4) *The Future of Poetry.* If we now turn to Poetry and Music, the great Arts which, together with the Drama, work in Time, we shall find two remarkable modern theories concerning them. These theories are remarkable for their similarity, and because they tend to show that the Golden Age of Perfection of Form which was gradually attained in Poetry and Music, is now over, and that we are living in an artistic age which rebels against what it considers to be the tyranny of Form. First, then, Mr. Carlyle held that the

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* Ruskin, *Laws of Fésole*, p. 3; *Eagle's Nest*, p. 44.

Age of Poetry is past, and that metrical language is now an anachronism. It is true that in all countries Prose is the daughter of Poetry, but it has unfortunately happened that men—looking as usual at the form rather than at the substance or purpose—have always divided Literature into Poetry and Prose, whereas the just contrary of Prose is not Poetry, but *Verse*. All language tending to produce noble thought or emotion is Poetry, whether the form used be metrical or not—whether, in other words, it be Verse or Prose. Hence there is much prose, both ancient and modern, which is true and often noble poetry; and, on the other hand, a vast quantity of literature wearing the poetical garb of metre which is, alas, anything but Poetry. Prose has for a long while been gradually encroaching on the domains of Poetry; but as emotion always tends to become rhythmical, it is probable that many metrical forms of language will never be superseded.*

(5) *The Future of Music as a Separate Art.* The other theory, that of Richard Wagner, is undoubtedly worthy of the most serious consideration, for it threatens with absolute extinction the beautiful art of Music, at least, in the form that we have known and loved from our youth up. Wagner's well-known theory is that instrumental music as a separate art is at an end, and that music must henceforth be united with and subordinated to the drama and dramatic poetry. Not content with this, Wagner holds, as a disciple of Schopenhauer, that rhythm is an intruder in the domain of pure music, and, *a fortiori*, musical *form*, which is founded on rhythm. Wagnerism thus strikes at the very root of the modern art of music as it has grown up during the last three centuries. But the theory appears to be radically wrong, for two principal reasons. First, considered from a psychological point of view, it is a reaction against

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* See Principal Shairp's *Aspects of Poetry*, pp. 57–60.

the extreme results of the process of separation or differentiation which the evolution of the Arts has ever exhibited. It is a putting back of the shadow on the sun-dial of Art to that primitive time when, as Mr. Herbert Spencer tells us,* Music and Poetry had not yet been separated, and before Vocal Music had given birth to her offspring, Instrumental Music. But Nature seems to aim at the evolution of individuality and individual perfection in Art as in life; just as the State merely exists for the benefit and welfare of its individual members. The artistic union of Poetry, Music, and Acting, or of any two of them, can only be attained through the surrender by each art of part of its own individual perfection—in fact, by a kind of mutual compromise. Hence the art-form known as the Opera is not a higher, but a lower form of art than either the orchestral symphony, on the one hand, or the drama proper on the other. Each one of the three arts concerned in the opera suffers by the combination, and no amount of the adaptation which composers (and especially Wagner) have so skilfully made use of can altogether hide the defect. Therefore, the highest ideal of musical art is found not in any word-bound music, but in such art-forms as the symphony or sonata, where the composer's fancy is free to roam through the realms of tone untrammelled by vocal requirements. And the highest ideal of the drama is that which is unfettered by music. It is but fair, however, to admit, that the opinions of high authorities differ on these points.

But the second objection to Wagnerism appears to be still more fatal to it. It is the rejection of all musical *form.* Now, beauty of Form is the very essence and life of Art, and especially of the two non-imitative arts, Music and Architecture. Regular form is as characteristic of Art and of life, as absence of form is of disintegration and death. For in Form we have the co-operation of varied means to a unity of end, according, as Mr. Ruskin beautifully puts it, to that great law of Help which is characteristic of Life.*

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* *Essays*, vol. i., pp. 24, 25.

Hence there can be no such thing as absolute freedom from form, or, in other words, from law and order, in music or any other art any more than in life. Such so-called "freedom" means simply anarchy and confusion. The highest beauty, both in Life and Art, and in the visible Universe, consists in an unconscious and free submission to Law and Order. And the law of art-evolution is not from form to so-called "freedom," but from fixity or rigidity of form to freedom of form. A time comes in religion, law, and every other branch of human thought when a relaxation can no longer be restrained from that rigidity or conventionality of forms and rules which, in accordance with some deep mental law, has inevitably grown up. In Music the golden age of perfection of Form was reached in the days of Haydn and Mozart; and the subsequent history of the art has shown a gradual decline of the influence of Form.

IV.—ÆSTHETIC ASPECTS OF CHARACTER, LIFE, AND THOUGHT.

In those Arts which deal with the delineation of human character, namely, the Drama and Fiction, the importance is at once evident of the study of the æsthetic aspects of Character. The highest beauty in character is perhaps beyond the power of Art, or even of morality, to give, for it lies in something which is far beyond and above them. In order to catch the golden rays of beauty, our actions must rise above the dull level land of ordinary morality or goodness into the unconstrained, warm atmosphere of spontaneous and unpremeditated sympathy and affection.

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* *Modern Painters*, vol. v., 160.

Herbert Spencer recognises this truth when he tells us that the range of æsthetic gratifications is wider for the altruistic nature than for the egoistic nature;* for sympathy with human joys and sorrows is ever the chiefest element in Art.

The true province of Æsthetics includes not only all that Art can do to render our homes and daily life and conduct more beautiful, but also all that can aid and foster our appreciation and love of whatsoever is worthy and beautiful in Nature, in human life and character, and in the noble and expressive language of Art itself. Our lives need more of that rest which is necessary for the true perception and enjoyment of beauty. Even the most lovely music or poetry, were it not succeeded by silence and interspersed by rests, would become unbearable; and it is even so with the music of Life.

And lastly, to turn to our inner thought-life, how much we can do to render it beautiful by training the mind to dwell habitually on pure, noble, worthy and lovely things. No one, says Mr. Ruskin, has told us "what fairy palaces "we may build of beautiful thought, proof against all adver-"sity. Bright fancies, satisfied memories, noble sympathies, "faithful sayings, treasure houses of precious and restful "thoughts, which care cannot disturb nor pain make "gloomy, nor poverty take away from us—houses built "without hands, for our souls to live in."†

V.—The Graver Aspects of Æsthetics.

Having thus very briefly considered a few of the subjects with which the practical portion of Æsthetic Science will have to deal, let us, in conclusion, turn our thoughts for a moment to its graver aspects. It may, I think, be said that this science, and the sister one of Ethics, point in even a far more distinct and unmistakable way than any other sciences to the existence of an unseen world, and of a Divine Author and Controller of the universes, both seen and unseen, both temporal and eternal. For Æsthetics and Ethics deal with, and rest upon, not mere physical and mental phenomena and laws alone, but something far higher, namely, those ideals of perfect beauty and goodness to which both Nature and Art, with their manifold imperfections, ever strive to attain, and in the meantime gloriously shadow forth.

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* *The Data of Ethics*, 3rd edit., p. 214.

† *The Eagle's Nest*, p. 198.

This it is which gives to both Art and Science that religious character upon which the author of the recent remarkable work on Natural Religion so strongly insists.* For neither Art nor Science can, any more than Religion itself, afford to dispense with ideals—those "winds of the soul" (ψυχῆς ἄνεμοι)—which, by giving us energy and enthusiasm, prevent mental stagnation, elevate and ennoble our thoughts and aspirations, raise man above himself, and show how truly "we live by admiration, hope, and love."

* *Natural Religion*, pp. 124, 127.

SOME RECENT EXPERIMENTS IN "THOUGHT-TRANSFERENCE," DIRECTED BY MALCOLM GUTHRIE, J.P., AND REPORTED BY JAMES BIRCHALL.

CONSIDERABLE attention has been given to the kind of experiments known as "Willing" and "Finding," in which a person, blindfolded, performs a definite series of actions, or finds some object under the supposed mental direction of another with whom he is placed in personal contact. These operations are apparently effected by the skilful interpretation of the voluntary or involuntary muscular indications given by him who appears to direct the other's movements, and do not require any further explanation.

Suppose, however, that the operator, fixing his eye intently upon some object, is able by simple contact, to transfer the image of that object—its colour and form—to the mind of the other, it is plain that there is room for further inquiry; and still more so, if the person who is blindfolded can, without contact, perceive the form and colour of the object as clearly as before—the picture being, to him, "a vision as sensible to feeling as to sight."

The following series of experiments, made in the presence of reliable witnesses, some of whom are members of this Society, point to the conclusion that there is a field open for such further inquiry.

The experiments originated with a party of lady friends trying to think out numbers and words. They were then taken up by Mr. Malcolm Guthrie, who had, before this, found his son possessed, at times, of the faculty of seeing objects, blindfolded "in form as palpable" as if they were before his open vision. Since then they have been conducted by him, with my assistance, and the occasional presence of Professor Rendall, Principal of University College, Dr. Carter, and Messrs. Davies and Steel. Care has been taken that sufficient safeguards should surround each experiment; that the blindfolding of the subject should be secure, and that where contact was permitted it should be confined to the clasping of the hands, or the simple touch of the fingers. In the large majority of the cases, the objects were placed behind the sitter, but in full view of all in the room. They have been kept in Mr. Guthrie's special custody, and he has never shown them except at the moment when each one was required. On one occasion I produced some objects prepared by myself, which could hardly have been anticipated by any of those present.

I have attended five sittings in town, and two at the residence of Mr. Guthrie, and the ladies before alluded to, have been present at all but one. Fifty-two experiments have been made—of which fifteen were failures, and the remainder either wholly or partly successful. One of the subjects displayed the possession of a marvellous power of intuition; as she failed only six times out of thirty-five; while she was correct in all the fifteen experiments made without contact.

The following is an enumeration of the experiments as they were made with each subject:—

I. Miss R——h in contact with Miss J——, or Miss R——.

The six failures were

1. A number—"17"—was said to be 16.

2. Only the first figure on a Bank note was deciphered, and at the second attempt.

3 & 4. A horse-shoe shape of blue silk on white satin, and a ring of white silk on black satin, could not be seen.

5. A bright steel door key, while pronounced to be bright, was thought to be a silver brooch, and

6. A Red Ivory ball was declared to be yellow.

The successful experiments were

1. A Red circle of silk on black satin, seen as "a round red spot."

2. A triangle of blue silk on black satin described as "blue—like a diamond—yet not a diamond, but like as if it were cut off, and pointed at one end."

3. A key—correctly named almost on the instant.

4. A watch—said to be "bright and round," but thought to be "a button."

5. A square of pink silk on black satin said, almost instantly, to be "pink and square."

6. A gilt cross—described as "yellow"—thought to be "a cross," and when asked which way it was held, replied correctly "the right way."

7. A piece of white cardboard, cut out in the shape of a jug, elicited the answer, "I cannot see any colour—looks all light—is it a cup? There is a handle—Oh! it is a jug."

8. A similar cardboard shape of a five-barred gate was declared to be of "the same colour as the last—seems to be all lines—with another line across them—so—(drawing a line diagonally)—do not know what it is—seems to be nothing but lines."

9. An electro-plate egg-cup was described as, "Is it a narrow stem? Goes on till it gets wide. Is it a wine glass? Seems bright—seems to be silver."

10. A toy, in the shape of a white cat, with black stripes radiating from a dark coloured back. Not seen

distinctly, nor the form deciphered, but said to be, "White all round—like with a black centre, and crimped in and out."

11. Six of diamonds. Answer, "It is yellow—square—it is a card. Red—cannot tell how many spots—seem to be two or three, one over the other—diamonds—cannot see the number—card seems to be moving about. It is the seven of diamonds."

II. The experiments with the same Miss R——h, sitting apart from the rest, and without contact, were remarkable.

1. A gold cross was almost instantly said to be "yellow," and pronounced to be "a cross."

2. A red ivory chess knight was thus described. "It is red—broad at the bottom—then very narrow—then broad again at the top. It is a chessman." When asked to name the piece, said she did not know the names of the pieces.

3. A half-crown, shown by Mr. Birchall, on the spur of the moment, was described as, "round—bright—of no particular colour—silver—a piece of money—larger than a shilling, but not as large as ——." Here the subject was unable to say more.

4. A diamond of pink silk, on an oblong of black satin. Only the colour of this was seen, the subject stating that she could not make out the shape, as it seemed to be moving about. The object was held in the hand of Mr. Guthrie somewhat unsteadily.

5. A red cloth-bound book, large quarto. Colour again seen, but not the shape.

N.B.—This was not at the same sitting as the preceding case, nor at the same time.

6. A yellow paper knife. Described as yellow—asked

if it was a feather, but presently said, "It looks more like a knife with a thin handle."

7. Mr. Steel's Exchange pass ticket was correctly described as, "Square—longer one way than the other, and of a dark reddish colour."

8. A pair of scissors. Answer: "It is silver—No—it is steel—It is a pair of scissors, standing upright."

9. A diamond of blue silk on black satin. Answer: "Is it blue? Is it a diamond?"

10. A dark green circle of silk, on black satin. The colour seen, but not the shape.

11. A terra-cotta pipe, glazed at the mouth. Answer: "Is it yellow? Does not seem to be all yellow—only one part of it. Can't see the shape well—all confused—do not know what it is. Seems to be a lot of stems. It looks like this (tracing an oblique line in the air) with claws." (The subject here shaped her fingers like claws.)

N.B.—The stem was joined to the bowl of the clay pipe by a carved bird's claw.

12. A small toy dog, coloured light-brown, with tail extended, and in the act of leaping, elicited a more remarkable answer, but not at the same sitting. The subject said: "Is it green?—I can see something like as if it had a lot of branches. Can't count them. Look too many. Like a long stem—so—(tracing a horizontal line in the air)—with things down (tracing lines downward). Looks to be of a lighter colour now—not green, as at first. It looked like a tree at first—now it looks like some kind of an animal. Can't see any more."

13. A dark-crimson apple was described as, "Round—of a dark-red shade—like the knob off a drawer. Is it an apple?"

14. An orange, next shown, was immediately detected. "It is not another apple. It is an orange."

15. An electro-plate spoon was said to be "very bright. Either steel or silver. Is it a spoon?"

III. Miss E——, in contact with Miss R——h (the previous subject).

1. The word, "*Via*," letter by letter. *V* was given at the first answer; *i* at the second, *h* being first named; and *a* at the second, after *z* was suggested.

2. The word, "*Res.*" Each letter was correctly given at the first answer. "Q" and "F" were afterwards shown, and answered correctly at once.

3. The word, "*Puella*," given by Professor Rendall. *P* answered at the second trial, *Q* being first named. The remaining letters were each named at the first trial.

4. A yellow silk cross, on black satin. Failed when in contact with Mr. Birchall; but when placed in contact with Miss R——h, answered: "It looks light—yellow like—seems like a lot of rings—Is it round? Cannot see any shape."

5. The word, "Tom," was next attempted by Miss E——, in contact with Miss R——h, on the understanding that she was to read the word at once, without spelling it. Answered: "Are there three letters? One is an "O"; one is a "stroky" letter—is it "T"? Oh! it's "Tom."

IV. Miss J—— in contact with Miss R——h.

1. Ten-of-spades, named correctly almost on the instant.

2. Three-of-hearts. Failure—eight being named.

3. Five-of-spades. Failure—six and four named.

4. A bright green silk oblong on black satin. Answer: "Is it square? Is it green?"

5. The same green oblong, with two spots of black silk placed on it. Answer: "There are four corners—It is long—black—I can see a lot of black, but it is rather mixed—Is

it a card?" When asked how many spots there were, supposing it were a card, replied "Three."

6. Six-of-clubs and a square of scarlet silk on black satin. Both failures.

7. Seven-of-diamonds, and an amber coloured cross of silk on black satin. Both failures.

V. Master Guthrie, in contact with his father.

1. Six of diamonds. Answered, "six," and then releasing his hands, traced the shape of a diamond in the air, saying, "diamonds."

2. A white ivory chess castle. Answer, "castle in chess."

Both the above objects were held at some distance behind the percipient.

3. The word "tram" was then written in plain print capitals, on a blackboard, in front of Master Guthrie, but none of the letters were deciphered.

4. A red circle of silk was then shown on black satin. This also was a failure.

5. The queen of diamonds, next shown, was at first said to be the queen of hearts, but immediately corrected,—"No—not hearts—diamonds."

VI. Another sitting, held at the house of Mr. Guthrie, at which Dr. Carter and Mr. Steel were present, also proved a failure on the whole, the novelty of the surroundings and the presence of strangers apparently unfitting the subjects for the experiments. Miss R——h, however, before mentioned, succeeded, in contact with Mr. Birchall, in localising three pains, two imaginary, and one real. The latter, caused by the grip of a strong wooden letter-clip, fixed upon the little finger of Mr. Birchall's left hand, was distinctly described by Miss R——h, as a pain caused by the "grip of something," but was said to be in the thumb of the left hand.

VII. A sitting, at which I was not present, may here be mentioned, in conclusion. One afternoon (13th April), Mr. Guthrie, without giving previous notice, asked the ladies to allow the Rev. H. H. Higgins to see their experiments. They were all busily engaged at the time, and were therefore somewhat fluttered by the suddenness of the call. The venerable and philosopher-like appearance of our friend still further awed them, and the consequence was, that all their experiments ended in failure.

ON THE STRUCTURE OF THE POLYCARP AND THE ENDOCARP IN THE TUNICATA.

By ALICE HEATH.

The simple Ascidians present many well-marked characteristics which have been recognised by all modern naturalists as of sufficient importance to place them as a distinct group of the animal kingdom, and, since their relationship to the Vertebrates has been established, there is no point in their life-history which has not received more or less attention from careful observers; and from time to time fresh information has been added to our stock of knowledge regarding them.

The adult simple Ascidian is very generally firmly fixed at one end to rocks and stones. Externally it presents few points of interest, for it is completely surrounded by a leathery or gelatinous envelope communicating with the interior by two openings only, known as the branchial or oral aperture and the atrial aperture. These two openings communicate respectively with the branchial sac and œsophagus, and with the atrial cavity or peribranchial space.

If now we cut into and remove this firm, tough, leathery covering, which is called the test, we shall come to a substantial mass of muscular tissue, smooth and firm on its outer surface where it is adherent to the test. This muscular layer is the mantle, and to it, and to sundry organs connected with it, we shall constantly have to refer.

The interior of the mantle forms the walls of the peribranchial space which communicates with the exterior by the atrial aperture. In this space the branchial sac is suspended; it is attached to the mantle at intervals. On the dorsal edge of the interior of the branchial sac is the opening which leads into the œsophagus, and thence to the stomach and coiled intestine. The whole of the alimentary canal usually lies on the left side of the animal, between the branchial sac and the mantle. The bending of the intestine upon itself is a very characteristic feature amongst the Ascidians, and it is in the loop thus formed that the hermaphrodite reproductive glands are frequently found; they are, however, sometimes placed in other positions, one of the most general being in the mantle walls of the peribranchial space. Here they may be grouped into one mass, or they may consist of several masses scattered over the surface of the mantle. When the reproductive organs are thus placed in many groups upon the mantle, they are known as "polycarps."

The polycarps often vary, even in the same individual, in shape and size. Their shape may be described as round, cubical, or oblong; and they are arranged, according to most observers, in more or less definite rows. On one or more points in each of these masses a small prominence may generally be observed.

Besides the polycarps there are a number of smaller, soft, greyish masses growing upon the mantle, and lying between the polycarps. These bodies have been called endocarps; they appear to be simply outgrowths of the mantle, and present the same appearance in all forms.

The earliest account which we have of these bodies is probably that given by Cuvier.* He speaks of the extreme development of the muscular tissue in his *Ascidia microcos-*

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* *Mémoires pour servir à l'histoire et à l'anatomie des Mollusques. Mém.* xx., p. 19. 1817. This is the earliest paper of Cuvier's which I have seen which refers at all to these organs; as, however, Savigny evidently refers to the passage quoted, Cuvier's opinion of the function of the endocarps must have been known some time anterior to the publication of Savigny's *Mémoires* in 1816.

mus, and does not apparently distinguish between that and the polycarps. With regard to the endocarps, he says, "the most singular point to be noticed is the presence of lobes of a gelatinous substance, without any apparent organization interposed between the fleshy mantle and the branchial sac. They apparently subserve some nutritive function, like the fat of other animals."

Savigny [*] figures and describes these organs as seen in *Polycarpa pomaria* (*Cynthia polycarpa* of S.) in his *Mémoires*, published in 1816. After referring to their large number, and to the apparent absence of oviducts, he says:—"The ovaries are hemispherical or conical bodies adherent to the fleshy mantle; they are formed of a mass of grains comparable to the eggs of other species, and their appearance is exactly that of a compound berry held by a calyx with five divisions. These ovaries are accompanied at their base by transparent, short-stalked, gelatinous vesicles. These vesicles are largely supplied with blood vessels." The vesicles are the bodies since called endocarps.

No further important observations appear to have been made as to the structure of the polycarps until the researches of Hancock, the results of which are embodied in a paper read by him before the Linnean Society, in 1868.[†] He says:—"When fully developed the so-called ovaries form protuberant, ovate, orange-coloured masses, each having at the attenuated extremity a projecting, nipple-like papilla. This is the oviduct leading out of the ovarian mass. Firmly attached around the base of these sacs is a series of pale, oval vesicles, which are sunk in the substance of the mantle, and which form for each sac a sort of cup, within which it rests. These vesicles are the male secreting organs, and their ducts, extremely delicate tubes, pass upwards over the surface of the sac, and go to join on the median line a slender vas deferens, which, passing forwards, terminates at the extremity of the short nipple-like oviduct above described. Thus it is seen that the so-called ovarian mass is a compound organ combining both the male and female parts, each with its proper secreting organ and duct." Referring to the endocarps, he says, "They do not seem to have any high functional import, their office apparently being to form, along with the generative bodies, a sort of pad or level surface for the support of the branchial sac, which otherwise might suffer from the inequality produced by the genitalia."

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[*] *Mémoires sur les Animaux sans vertèbres.* 3^{e} *Mémoire*, page 96. Savigny.

[†] On the Anatomy and Physiology of the Tunicata. Hancock, *Journal of the Linnean Society*, vol. ix.

The grouping of the genitalia into polycarps was considered by Heller* of considerable classificatory importance, and in his work on the Ascidians, published in 1877, he separates those Ascidians having polycarps from the other Cynthiidæ, with which they had previously been classed, and formed the genus *Polycarpa.*

So far as I am aware, no further observations on the structure of polycarps have, as yet, been published. Those which I have made in the Zoological Laboratory of University College,† Liverpool, have been upon *Polycarpa pomaria, P. comata,* and *P. glomerata.* The two former are simple, solitary species; the latter is a gregarious form. The method employed in examining *P. pomaria* and *P. comata* has been to make sections in various directions through the polycarps, to stain the sections in picro-carmine, and to mount them in Farrant's solution.

In *P. pomaria* the test was removed, and a series of sections, in different directions, made through the mantle and the adhering polycarps, in order that the relationship to each other of the different parts of the organ and their minute structure might be observed *in situ*. (Pl. I, Fig. 2). In the first place, we notice the muscular layer or mantle, the inner portion of which is less muscular than that near the test; it assumes more the character of a connective tissue, and is raised and expanded to cover the polycarps, and to form a firm boundary to them on that side which projects into the peribranchial space, forming, in fact, a kind of capsule to the organ. This is covered by a delicate epithelium, the third tunic of Milne-Edwards. The internal structure of each polycarp is essentially the same; at the base of the organ, that is, the part nearest the muscular layer of the mantle, several comparatively large, irregularly oval, slightly lobed masses may be observed; sometimes they project into the centre of the organ, and sometimes may even be found near its apex. In most cases these masses form a broad base to the organ, and are probably the structures referred to as a calyx by Savigny, who seems to have been unaware of their actual nature; their true significance as the testes was, however, recognised by Hancock. In some cases these masses may be observed to end in a narrow tube, the vas deferens, which is continued forward to the walls of the polycarp, in which it seems to travel for some distance. (Pl. I, Fig. 3.) In transverse section the vas deferens is seen to be round or oval, and is completely lined by a layer of cubical, densely ciliated cells; when cut longitudinally, the cilia may be seen to point down the duct towards the gland. Resting upon the testis is the ovary, which here, as elsewhere, may be easily recognised by its contents, the clearly-defined egg-cells. In the midst of this mass of cells may be noticed one or two large, crescent-shaped ducts; in the smaller polycarps only one is present, and this is generally placed near the apex of the organ; in the larger polycarps there are always two, one on either side of the organ. On examining these ducts with a higher power, we see that one side of the duct, that on the inner side of the organ, is slightly crumpled, and is lined by a layer of small, cubical cells, thickly fringed with long delicate cilia; while the other side shows a smooth even edge. The horns of the crescent always point towards the mantle. These crescent-shaped, semi-ciliated ducts, are the oviducts; they open into the peribranchial space through the papilla noticed by Hancock. In some of the sections which pass through the papilla the ducts appear to be ciliated on one side only, while others show cilia on both sides. (Plate II, Figs. 4 and 5).

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* Untersuchungen über die Tunicaten des Adriatischen und mittelmeeres. III (1) Abth.

† Under the helpful and suggestive direction of Professor Herdman.

In *P. comata* the sections have been made through the test, mantle and polycarps, and show the natural relations of these parts to each other. (Plate III, Fig 6.) The polycarps here show certain points of resemblance, and also of contrast to those of *P. pomaria*. They are not so crowded together, and the connective tissue portion of the mantle between them is much more largely developed. The general relationship of the testes and ovaries to each other remain the same as in *P. pomaria;* the mature ova, as pointed out by Kupffer,* are, each of them, surrounded by a delicate membrane, which he calls the egg-follicle, the cells of which appear spindle-shaped in section and hexagonal in a superficial view; the mature eggs are contracted away from the follicle, and appear not to possess a vitelline membrane. The mature ova do not stain readily, and frequently remain of a greenish tint. The oviducts which in *P. pomaria* were such a marked feature, are here scarcely recognisable; they are very narrow, being much less in diameter than the size of a mature ovum; the walls are smooth, and have no characteristic lining; there is apparently no definite path for the duct through the ovary; in some sections it is somewhat crescent-shaped, while in others it passes through the ovary to the papilla, by which it opens into the peribranchial space. (Pl. III, Figs. 7 and 8.) The vas deferens, I have not, as yet, been able to trace.

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* Die stammverwandtschaft zwischen Ascidien und wirbelthieren Archiv. für mikr. anat., 1870. Kupffer's observations were made upon *Ascidia* (*Ciona*) *canina*, but appear to apply equally well to ova developed in the polycarps of *Polycarpa comata*.

Polycarpa glomerata is a much smaller species than either of the preceding ones; many of the tissues are thinner and more transparent, and the method of cutting sections was not resorted to. When removed from the test, the mantle was divided throughout its whole length, and one half of the branchial sac, with the alimentary canal, having been removed, the whole was stained and mounted. In this animal the arrangement of the genitalia is somewhat different to that of the preceding specimens. The two reproductive glands are not grouped together, but form two distinct series of organs. (Pl. IV, Fig. 9.) The testes are scattered about over the whole of the left side of the surface of the mantle; they are not found on the right side; they are flask-shaped bodies of varying sizes; through the narrow neck of the flask the duct evidently passes to open into the peribranchial space; the neck of the flask is turned more or less towards the atrial aperture. Endocarps are placed on both sides of the mantle. The ovaries are seven or eight in number; they are placed on the posterior and ventral side of the mantle, almost immediately beneath the endostyle, where they form a row of rosette-like bodies. The capsule is so exceedingly thin as to show the ova through without further dissection; on one side of the ovary is a narrow, neck-like papilla—the oviduct. (Pl. IV, Fig. 10.)

Endocarps are not confined to those Ascidians which have the reproductive organs arranged as polycarps, but are found in such species as *Styela grossularia* and others.

One point in the anatomy of the genitalia of *Polycarpa pomaria* seems to call for some further explanation. The arrangement of the oviducts is so marked as at once to attract the attention of a student observing such a series of sections as has been described, and the question naturally arises, what arrangement of the duct in the organ could possibly give rise to so regular a distribution in section? I can only suggest that it is possible that the duct is compressed laterally, and is slightly folded on itself, and that it takes a circular path through about the middle of the ovary, that it lies everywhere parallel to the mantle, and that it is the inner, convex side of the duct which is ciliated. Sections through the central part of the polycarp would thus pass through the duct at two points, and give rise to the appearance of two crescent-shaped ducts, one on either side of the ovary. At the same time, sections which pass through the periphery of the organ cut off simply a segment of the ovary, and give rise to the appearance of a section of a small polycarp with one central duct. The direction of the duct will, of course, be somewhat modified as it passes from the ovary to the peribranchial space, and this will probably account for the fact that occasionally sections through the papilla show the duct ciliated on both sides, such sections having passed through two points in the ciliated half of the duct.

Plate I.

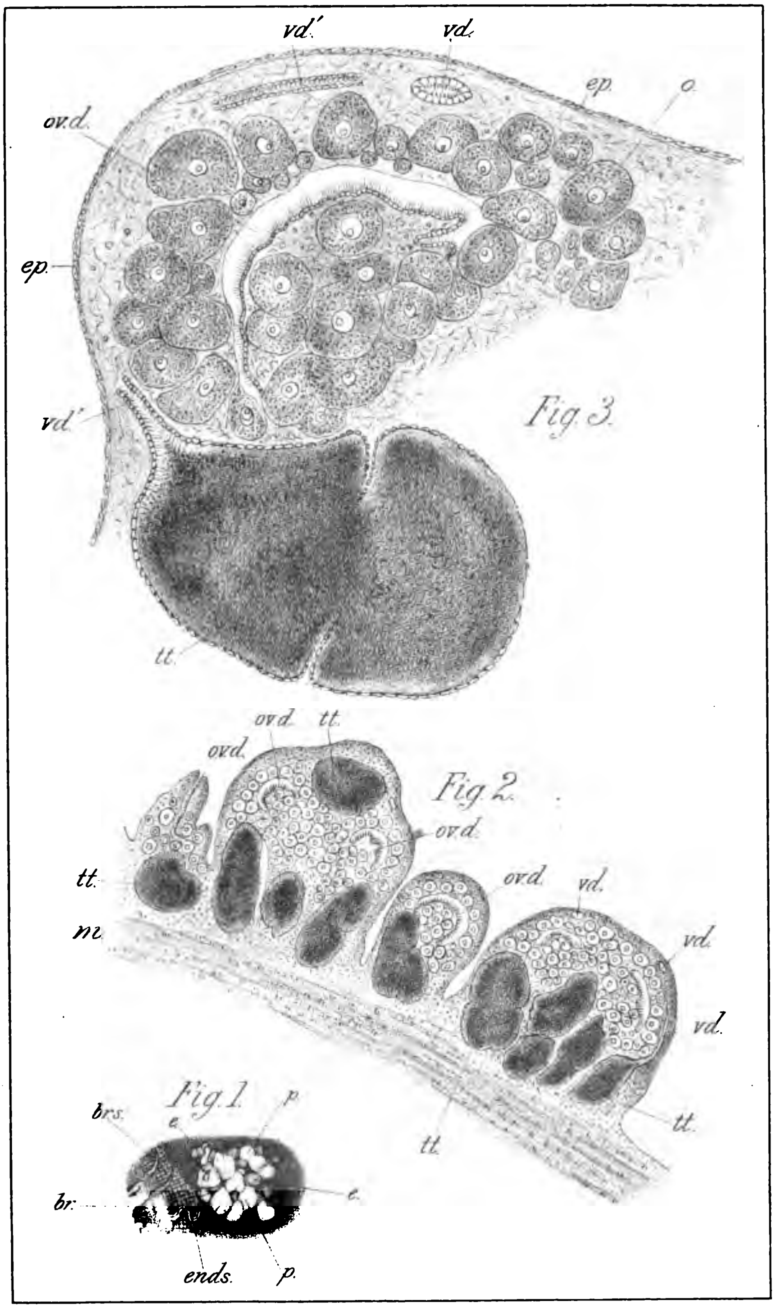
vd.'
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Fig. 3.
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Fig. 2.
ov.d.
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Fig. 1.
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Plate II.

Fig. 4.

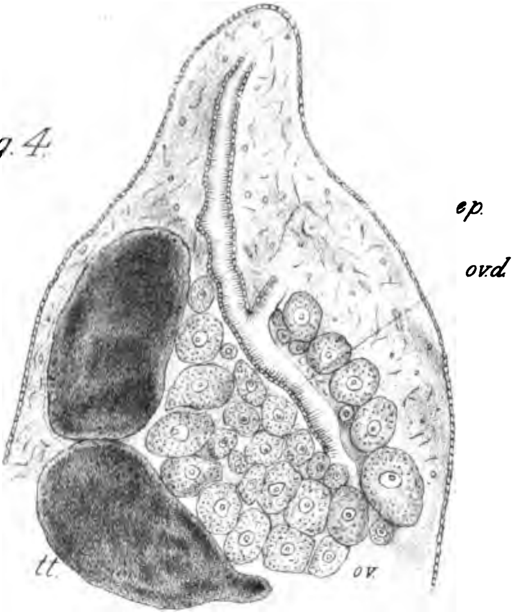


Fig. 5.

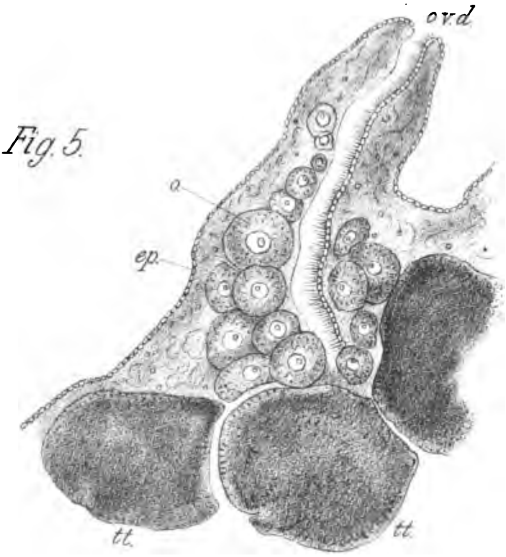


Plate III.

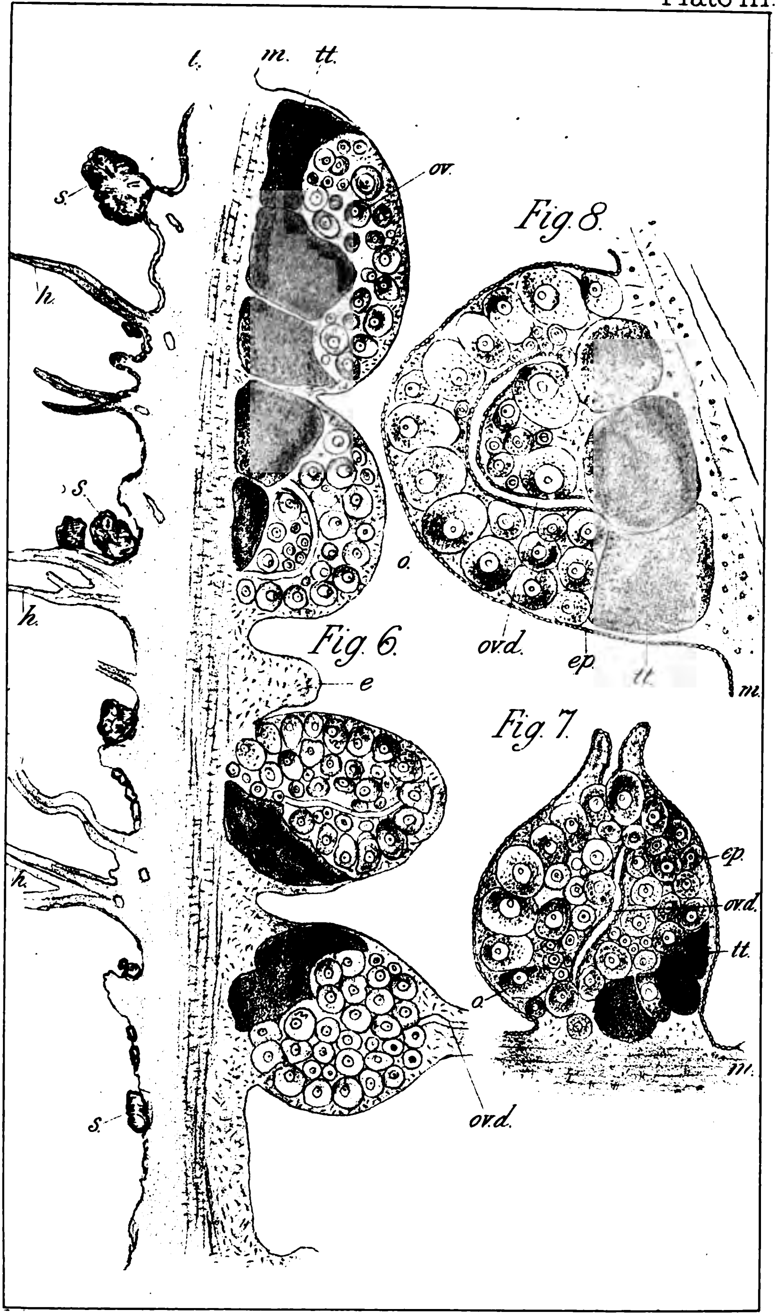


Plate IV.

Fig. 10.

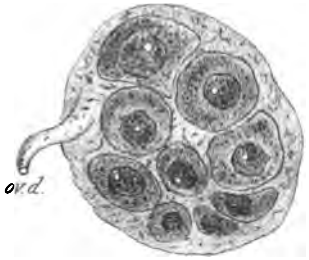
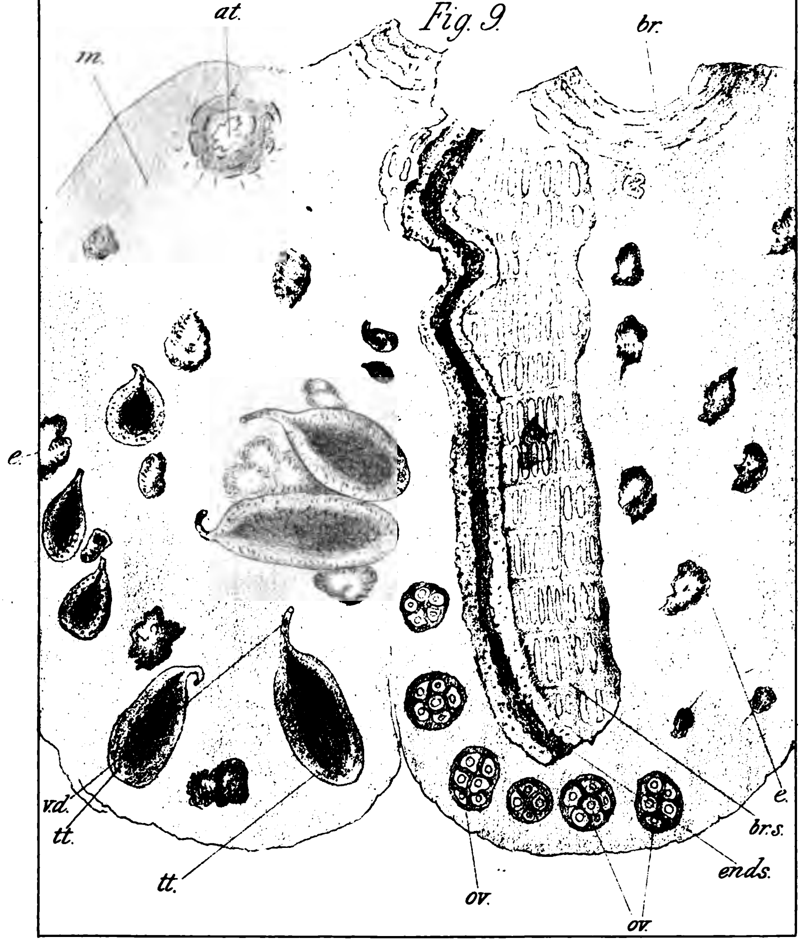


Fig. 9.



EXPLANATION OF THE PLATES.

The following system of lettering has been adhered to throughout:—m., mantle; t.t., testis; v.d., vas deferens, in transverse section; v.d′., vas deferens, in longitudinal section; ovd., oviduct; ov., ovary; o., ova t., test; h., hairs, prolongations of the test containing blood-vessels; s., sand, adherent to the test; e., endocarp; ep., epithelium; br.s., branchial sac; ends., endostyle; br., branchial aperture; at., atrial aperture; p., polycarp.

Plate I.—*Polycarpa pomaria*, Savigny.

Fig. 1. Surface view of part of the inner side of the mantle. Natural size.

Fig. 2. Section through the mantle and four of the polycarps. 1 inch objective.

Fig. 3. Section through one polycarp. ⅛ inch objective.

Plate II.—*Polycarpa pomaria*, Savigny.

Fig. 4. Section through the papilla, showing the oviduct ciliated on both sides. ⅛ inch objective.

Fig. 5. Section through the papilla, showing the oviduct opening into the peribranchial space. ⅛ inch objective.

Plate III.—*Polycarpa comata*, Alder.

Fig. 6. Section through the test, mantle, four polycarps, and an endocarp. 1 inch objective.

Fig. 7. Section through a polycarp. ⅛ inch objective.

Fig. 8. Section through another polycarp. ⅛ inch objective.

Plate IV.—*Polycarpa glomerata*, Alder.

Fig. 9. Left side and part of right side of branchial sac, and the alimentary canal removed. 1 inch. objective.

Fig. 10. Ovary. ⅛ inch objective.

ODOURS, PERFUMES, AND FLAVOURS.

PHYSIOLOGY, PHILOSOPHY, HISTORY, SOURCES AND PREPARATION.

By ALFRED HENRY MASON, F.C.S., &c.

The sense of smell ordinarily requires for its excitement to a state of activity the action of external matters which produce certain changes in the olfactory nerve, and this nerve is capable of an infinite variety of states, dependent on the nature of the external stimulus.

The first condition essential to the sense of smell is the existence of a special nerve, the changes in whose condition are perceived as sensations of odour; for no other nerve is capable of these sensations even though acted upon by the same causes. The same substance which excites the sensation of smell in the olfactory nerves may cause another peculiar sense through the nerves of taste, and also affect the mucuous membrane of the eyelid—(the effect of horse-radish and of mustard illustrate this sensation) — but although these effects may be simultaneously perceived, the sensation of odour is separate and distinct.

The second condition of smell is a peculiar condition of the olfactory nerve, or a peculiar change produced in it by the stimulus or odorous substance.

The matters of odours must in all cases be absorbed by the mucus of the mucous membrane before they can be immediately applied to, or affect the olfactory nerves; therefore a further condition necessary for the perception of odours is that the mucous membrane of the nasal cavity be moist.*

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* When the Schniderian membrane is dry, the sense of smell is lost; in the first stage of catarrh, when the secretion of mucus within the nostrils is lessened, the faculty of perceiving odours is either lost or rendered very imperfect.—Todd and Bowman.

In animals living in air, it is also requisite that the odorous matter should be transmitted in a current through the nostrils. This is effected by the respiratory movements; hence we have voluntary influence over the sense of smell; for by interrupting respiration we prevent the perception of odours; and by repeated quick inspirations assisted by slight contraction of the nostrils (as in the act of sniffing), we render the impression more intense.

In respect to the acuteness of smell, many animals possess powers superior to man. Herbiverous animals are peculiarly sensitive to the odours of plants and flowers, but have a narrow sensibility to animal odours, especially to such as proceed from other than their own species. Carniverous animals, on the contrary, have the power of detecting by the smell the special peculiarities of animal matters, and of tracking other animals by the scent, but they have with singular exceptions apparently no susceptibility to the odours of plants and flowers.

Man's sphere of susceptibility to various odours and perfumes is more uniform and extended, and our appreciation and use of perfumery has been more developed as civilization and education have advanced.

The sense of smell is the one probably least cultivated by most of us; the developement of this sense towards the detection of odours is to my mind one which should be instilled into the young just as necessarily as the detection of sounds, or the power to distinguish colours. To the untutored nose most odours are alike, but when educated either for pleasure or profit no nerve is more sensitive. In their ordinary vocation, medical men, chemists, druggists, wine merchants, cigar manufacturers, tea and coffee merchants, hop dealers and others, have to undergo a regular educational course in the sense of smell; and be our intuition imperfect or no, we are aware that when the olfactory nerve is excited by an odour, the impression is rapidly and vividly transmitted to the brain, producing an agreeable or disagreeable effect as the case may be, and acquiring somewhat of a mental character, just as when the retina receives an impression from a painting, or the ear a musical sound.

Persons who are anosmic have no power to distinguish odours—"noses have they, but smell not," just as sound is not heard by one who is deaf; on the contrary, there are persons who are Hyper-osmic—very sensitive to odours—of such is the sanitary inspector of nuisances.

I would observe that odour and perfume are not synonymous—the former designates any agreeable or disagreeable emanation, while the latter conveys the idea of an agreeable odour only, and at the same time the substance which furnishes it.

Shakespeare thus defines the distinction in two of his plays. In "*King John*" Constance calls death "an odoriferous stench;" and in the "*Taming of the Shrew*," Gremio directs that the papers he sends to Bianca should be well perfumed, for "She is sweeter than perfume itself."

Flavour indicates that the substance has a combined action upon the nerve of taste as well as the nerve of smell.

The influence of the sense of smell over the frame is very remarkable and varied. One odour will instantly produce loathing, nausea, and vomiting with some persons, whilst others are not affected by it. Again, perfumes, to some most agreeable are to others intolerable, and different persons describe differently the sensations they severally receive from the same odorous substances.

An odour in general is an invisible imponderable emanation from fragrant substances. Odours cannot be propagated in the same manner as caloric and light; their movements are not submitted to the laws of reflection and refraction. They spread incessantly in the air, which is their vehicle, and follow the currents of the atmosphere; they are obviously capable of very wide diffusion, so much so that we can scarcely credit that at all times odour necessarily implies individuality. It seems that in numerous instances odour acts as an imponderable agent, rather than physical matter. It is clear that certain matters produce certain odours, but it is not equally definite that the matters in question are themselves the odours.

Piesse considers that we can understand the theory of odours by viewing them as imponderable agents, affecting the nervous system by special vibrations—presuming that such vibrations are caused by the chemical action set up by contact of essences and perfumes with the oxygen of the air. We are able to reduce them to an odourless state by excluding oxygen and volatilising them. The essences thus deprived of their odour receive it instantly on contact with the air. In all chemical combinations vibrations occur which give rise to luminous or electrical phenomena. In certain cases other vibrations are produced which affect the olfactory nerve system, and different odours have different velocities of vibration.*

Very interesting facts have been ascertained regarding the time required for the stimulation of the various organs of special sense, but until recently experiments have not been made on the sense of smell. Dr. Buccola, of Turin and Dr. Beaunis, of Nancy, have undertaken independent investigations, and arrived at results almost identical. The conclusions of the latter have recently been published in the *Gazette Medicale de Paris.* *

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* Piesse finds close analogy between odours and musical notes, and, to illustrate this, he has devised a gamut of odours—placing the odour in the position corresponding to its effect upon our olfactory sense.

Professor Newman has remarked that there is a point at which all sciences osculate. This becomes more apparent daily. The chemist must be a mathematician; so must the thorough musician. Optics have come to the aid of chemistry, the discovery of the metal thalluim revealed itself to our knowledge by a line of intense green light upon the spectrum. Thus, again, chemistry aids astronomy; spectrum analysis dealing with the solar and stellar light, enables us at least to conjecture what elements exist in other spheres of the universe. What shall we say of Piesse's theory, which finds close analogy between scents and sounds? There is a union between the sense of taste and smell on the one hand, and between sound and smell on the other, which indicates their *continuity*.

The interval which elapsed with the several substances enumerated was as follows :—

Ammonia	·37 sec.	Chloroform	·56 sec.
Acetic Acid	·46 „	Sulphide of Carbon	·59 „
Camphor	·50 „	Valerian	·60 „
Assafœtida	·52 „	Mint	·63 „
Sulphide of Ammonium	·54 „	Carbolic Acid	·67 „

If we consider the substances which were employed, we shall notice that in some cases they would probably excite the sensations of the nerves of touch also—we are, however, certainly aware that different odours have a different mode of action on the olfactory nerve, and thus variations are explicable.

Chemistry and natural philosophy have proved that an odour is produced by very small molecules which are disengaged by odoriferous substances; these molecules float in the atmosphere, hanging on different surfaces they meet, and communicating to them their properties. When these odoriferous molecules are in contact with the olfactory membrane the sense of smell is brought into action and the brain perceives the odour. The olfactory opparatus is therefore indispensable to the impression.

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* In these experiments the odorous substance was placed in a closed bottle. If not a liquid, it was dissolved in alcohol or water. Two holes were made in the cork of the bottle, and through these two tubes were passed, one reaching nearly to the level of the liquid, the other ending in the upper part of the flask. The end of the former was connected with an india-rubber injector, and the end of the latter tube was fitted with a suitable extremity for introducing into the nostril, stops being placed so that the odour should not escape until a desired moment. The compression of the injector drove a current of air from the interior of the bottle into the nostril. Another tube of the same length, communicating with the cavity of a tympanum and writing lever, serves to register the exact moment at which the wave of air reached the nostril, and an electrical signal was registered by pressing down a button at the moment that the sensation was perceived. A considerable time was necessary between different observations with the same substance, because otherwise the moment of sensation could not be accurately determined.

These odoriferous molecules are of such infinitesimal tenuity that bodies which disengage them all the time seem not to lose anything of their weight, or at least to make insensible losses. *

A rose in a few hours can perfume 10,000 cubic feet of air without losing its weight.

Haller kept, for forty years, paper perfumed with one grain of ambergris; after this time, the odour was as strong as ever.

One drop of oil of thyme will communicate its odour to twenty-five gallons of water.

According to the theory of Dr. Starch, of Edinburgh, the tissues of animal substances have more affinity for odours than those of vegetable substances, and the absorption of odours by outward tissues is subject to the same law that governs the absorption of caloric ; that is, black tissues absorb the most odour; and this absorption diminishes as the colour becomes lighter, in such a manner that white tissues are those which absorb odour the least. (This fact is of great value from a sanitary point, illustrating the importance of nurses avoiding dark clothing in a room where sickness and infection exist.)

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* It is recorded, and the record has been handed down in different works on the subject, that an exact calculation has shown that one grain of musk has in a radius of ninety feet disengaged in one day 51,839,616 particles without any diminution of its weight. This same grain of musk abandoned to itself for six months communicated its odour to all the objects in the room, and being re-weighed had experienced no loss.

Classification.—The extreme subtilty of odours has proved an impediment to their classification. Linnæus divided them into seven classes—aromatic, fragrant, ambrosial, alliacious, fœtid, repulsive, nauseous—of these the first three only are perfumes. More recent investigators consider this classification far from correct, for he placed very dissimilar flowers and leaves together.

Fourcry divided them into four groups, but Virey, finding them to be insufficient, established twenty orders.

De Haller divided them into three, but these several views were more classical than theoretical, for none classified odours by their resemblance to each other.

Mr. Rimmel's classification of perfumes,*—*i.e.*, only pleasant natural odours—seems to be accepted by modern

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* Rimmel's Classification of Odours.

CLASSES.	TYPES.	ODOURS BELONGING TO THE SAME CLASS.
Rose	Rose	Geranium, Sweetbriar, Rhodium, Rosewood.
Jasmine	Jasmine.. ..	Lily of the Valley.
Orange Flower ..	Orange Flower..	Acacia, Syringa, Orange Leaves.
Tuberose	Tuberose ..	Lily, Jonquil, Narcissus, Hyacinth.
Violet	Violet	Cassie, Orrisroot, Mignonette.
Balsamic	Vanilla	Balsam of Peru and Tolu, Benzoin, Styrax Tonquin Beans, Heliotrope.
Spice	Cinnamon ..	Cassia, Nutmeg, Mace, Pimento.
Clove	Clove	Carnation, Clove Pink.
Camphor	Camphor ..	Rosemary, Patchouli.
Sandal	Sandalwood ..	Vetivert, Cedarwood.
Citrine	Lemon	Bergamotte, Orange, Cedrat, Limette.
Lavender.. ..	Lavender ..	Spike, Thyme, Serpolet, Marjoram.
Mint	Peppermint ..	Spearmint, Balm, Rue, Sage.
Aniseed	Aniseed	Badiane, Carraway, Dill, Coriander, Fennel.
Almond	Bitter Almonds	Laurel, Peach Kernels, Mirbane.
Musk	Musk	Civet, Musk-seed, Musk-plant.
Amber	Ambergris ..	Oak-moss.
Fruit	Pear	Apple, Pine Apple, Quince.

authors. He adopts the principle that, as there are primary colours from which all secondary shades are composed, there are also primary odours, with perfect types, and that all other aromas are connected more or less with them.

The proposal to divide all odours into two classes, agreeable and disagreeable, will appear obviously defective, and only relative, for an odour agreeable to one person is disagreeable to another, and it would only classify the quality of odours and give no idea as to their individuality.

Odours impregnate all bodies in different degrees, and combine with nearly all liquids. Gloves retain for a long time the perfume of ambergris. Paper and cotton that of musk. Oils and greases retain balsamic and volatile principles. Water, and especially alcohol, dissolve perfectly the principle of flowers. The manufacture of perfumery in its various forms is founded on this knowledge, and thus the perfume of flowers, so light, so fugacious, with which we are charmed whilst summer lasts, and which would otherwise be scattered by the winds, is rendered stable by art and industry, to minister to the wants of a refined mind, and console us for the loss of flowers when nature has fulfilled her duty.

The roses soon withered that hung o'er the wave,
  But some blossoms were gathered, while freshly they shone,
And a dew was distilled from their flowers, that gave
  All the fragrance of summer, when summer was gone.

Thus, at the moment the perfume escapes from the flower, man seizes it, masters it, and uses it to increase the height of his enjoyment.

Different circumstances may cause the intensity of perfumes to vary, such as dampness, light, heat, and the addition of another substance also develops the strength of an odour, which alone is nearly insensible. Some flowers lose their fragrance as soon as they are culled; others, on the contrary, preserve it even when dry. Odours derived from the animal kingdom exceed all others in strength and pertinacity.

The majority of flowers and plants exhale an odour, more or less perceptible, more or less agreeable, some all the time, others at certain periods. Thus some have a stronger perfume at sunrise; some in the evening; and many orchidaceous plants during the night only. Meteorological causes have a great influence on the odours of living plants. Dew, or gentle rain, with intervals of sunshine, seem to be the circumstances best fitted for the natural emission of vegetable perfumes. Light has a powerful effect upon the odour as well as the colour of flowers; plants, when etiolated by being kept in darkness, generally lose their odour.

Criton, Galen, Hippocrates, and other ancient doctors, classified perfumes among medicines, and prescribed them for various diseases, especially those of a nervous kind. Pliny discourses at length on the various therapeutical uses to which flowers and plants may be put, and the Arab physicians derived many of their remedies from aromatics. At the present time the products of odoriferous plants are used in medicine, but not altogether, I presume, on account of their odours, but owing to some specific action which their application exercises.

It is true that science has made great progress and discarded many antiquated notions, but modern facts tend to show more and more that the ancients were not wrong in their estimation of perfumes as prophylactic agents. The important service which has resulted from investigations upon the theory of disinfection, and upon the antiseptic properties of odoriferous plants, must not be overlooked. Perfumes have been known for years to exercise an important service in protection from epidemics, were the only example that of the forty thieves, who, by means of their famous aromatic vinegar during the great plague at Marseilles, were so protected that they could rob the dead and dying without fear of infection.*

In the reign of Charles I. perfumes were extensively used as preservatives from the plague; and among the various specifics devised by the doctors of that period, a curious one is mentioned by Rushworth, which consisted in eating a roasted apple stuffed with frankincense, which was recommended as a certain cure. As late as the last century medical practitioners carried on the top of their walking-sticks a little cassolette filled with aromatics, which they held to their nose when they had to visit any contagious case; and the old custom of strewing rue before the magisterial bench at the sessions, as a protection against jail fever, has only been abolished in the presence of more theoretical sanitary precautions in the prisons.

It has been shown that the hygienic influence of pine on eucalyptus† forests is chiefly due to the production in and around of the products of the atmospheric oxidation of their essential oil, conducted in the presence of moisture, the intensity of the process being materially enhanced by the aid of direct sunlight.

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* When the island of Ternate was dispoiled by the Dutch of its clove plantations, the island was visited by a series of epidemics, which it had escaped whilst it possessed its *cordon sanitaire* of spice trees. As a more modern instance, it may be stated that during the various invasions of cholera, the perfumers' workshops, both in London and Paris, were spared from the scourge, an advantage which they shared with the tanners, and which they owed probably to the same cause—an atmosphere strongly impregnated with aromatics, for tan is also an aromatic *sui generis.*

† In a lecture on the "Eucalyptus Globulus," Professor Bentley, who has made a special study of this tree, and other members of the same genius, said:—"In a lecture on the Eucalyptus, which I delivered at the Royal Botanic Gardens, in Regent's Park, four years ago, I stated my reason for believing that the emanations from the leaves of the groves of the Eucalyptus had some influence in destroying marshy miasms, and thus improve the healthiness of the district. Since then, the very interesting researches of Kingzett have proved that, under the influence of air and moisture, both peroxide of hydrogen and camphoric acid are formed from volatile oils—the former a powerful disinfectant, the latter an antiseptic;

Pestiferous emanations are all of an alkaline, if not ammoniacal, character, and readily combine with the products of slow combustion, all of which are acid, or have an acid character in their chemical relations. Those subtle emanations which engender disease, whether derived from the malarious swamp, or as effete matter from the lungs of a disordered person, are at once destroyed by the odorous vapours resulting from slow combustion.

From odoriferous oils are produced stearoptines, *Thymol*, (from Oil of Thyme, is a type), and others, which being paraciticides, have the power of killing living germs, which initiate the putrefactive change; and *Menthol* (from oil of peppermint), has been found to relieve neuralgic and nervous headache, by being simply rubbed upon the affected part.

It is supposed that if odorous flowers are left in sleeping apartments all night, they will cause headache and nausea, but if this is the case, it cannot be due to the diffusion of their aroma, but to the small quantity of carbonic acid which they evolve during the night. A perfume, extracted from these flowers and diffused by means of a spray or vapouriser, would be agreeable, and no evil effect would arise from it. All that can be said is that some delicate or hyperosmic persons may be affected by certain odours; but the same person to whom a musky scent would give a headache, might derive much relief from a perfume with a citrine basis.

and hence I think there can now be no doubt that the healthy influence of Eucalyptus trees is, to some extent at least, and probably more than we imagine, due to the volatile emanations from the leaves, under the influence of air and moisture, possessing direct disinfectant and antiseptic properties, and thus destroying the injurious effects of patudal miasms."

Imagination has, besides, a great deal to do with the supposed noxious effects of perfumes.*

On the other hand, there are authors who say that the sense of smell is the sense of imagination. There is no doubt that pleasant perfumes exercise a cheering influence on the mind, and easily become associated with our remembrance. Sounds and scents share alike the property of refreshing the memory, and recalling vividly before us scenes in our past life. An effect which Thomas Moore beautifully illustrates in his *Lalla Rookh:*—

"The young Arab, haunted by the smell
Of her own mountain flowers, as by a spell
The sweet Elcaya, and that courteous tree
Which bows to all who seek its canopy,
Sees call'd up round her by those magic scents
The well, the camels, and her father's tents,
Sighs for the home she left with little pain,
And wishes e'en its sorrows back again."

Tennyson expresses the same feeling in his *Dream of Fair Women:*—

"The smell of violets, hidden in the green,
Pour'd back into my empty soul and frame
The times when I remember to have been
Joyful and free from blame."

HISTORY.—In a certain sense, of course, the enjoyment of perfume is coeval with the existence of the human race, as the flowers which bloomed in Eden must have ministered to the gratification of the senses of the progenitors of our race; the origin of perfumery, however, like that of all arts, is shrouded in mystery. Certainly, the use of perfumes, odours, and aromatics of every description has been known from the most remote antiquity, for when man discovered them his first idea was to use them as incense.

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* Dr. Colquet, who may be deemed an authority (as he made this subject a special study), says, in his *Treatise on Olfaction*:—"We must not forget there are many effeminate men and women to be found who imagine that perfumes are injurious to them, but their example cannot be adduced as a proof of the bad effects of odours. Thus, Dr. Thomas Capellini relates the story of a lady who *fancied* she could not bear the smell of a rose, and fainted on receiving the visit of a friend who carried one—and yet it was only artificial."

The word perfume—*per*, through—*fumum*, smoke—indicates clearly that it was first obtained by burning aromatic gums and woods. We find perfumes used in the primitive forms of worship, and we also find that their use was not long confined to sacred rites. The Egyptians from earliest times adapted them for private use, and they gradually became an actual necessity; their use to preserve animal tissues from decay, combined with the celebrated *natrum*, to mumify, shows the Egyptians were possessed of knowledge of their antiseptic properties.

The bdellium mentioned by Moses, in Genesis, is a perfumed gum, and several passages in Exodus and other portions of Holy Writ, prove that the use of perfumes was known (probably adopted by the Hebrews after their long captivity by the Egyptians). The composition of the incense and the method of preparation was prescribed, and any one who imitated this formulary and process was to be cut off from His people.*

The nations of Africa and Asia, Greece and Rome were prolific in their employ. More sensible than we are to the impressions which excite pleasure, the ancients considered the use of odours as necessary to their existence. At Athens and Corinth the love of perfume was so general that the people used to assemble at the perfumer's to gossip.

At Rome, women used such a profusion of perfumes, it was feared for a time that the resources of Arabia would be exhausted, and laws were made to prevent the abuse. In those times the passion for perfumes was so strong that rich and poor could not do without them. They were lavished everywhere, under every circumstance, in food and drinks, in the midst of feasts in which they celebrated Bacchus and Venus; in baths, on the body and dresses. There were no festivals, rejoicings, or funerals in which perfumes were not used. They were burned before the cradle of the newly-born infant, around the bridal bed, and on the marble of the tomb. They were offered to the gods and goddesses as a tribute and an homage; to glorify heroes, to honour kings, in temples, in the midst of palaces, in the public places, everywhere and at all times. All this might be illustrated in detail, but it is of more interest to us to trace the introduction of perfumes into this country. Stow writes :—

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* Gen. xxxvii.; Exodus xxx.; Ps. cxxxiii.; Exodus xl.; Numb. xvi.; 2 Chron. xxvi.; Is. xxxix.; 2 Chron. ix.; Cant. iv.; St. Mark xiv.; Ps. xlv.; Prov. vii.; Est. ii.; Cant. i.; St. John xix.; 2 Kings ix.

> "Milliners and haberdashers had not then any gloves imbroydered or trimmed with gold or silke; neither could they make any costly wash or perfume, until about the fifteenth yeere of Queen Elizabeth, the Right Honourable Edward de Vere, Earl of Oxford, came from Italy, and brought with him gloves, sweete bagges, a perfumed leather jerkin, and other pleasant things; and that yeere the queene had a pair of perfumed gloves, trimmed only with four tuffes, or roses of coloured silk. The queene took such pleasure in those gloves, that she was pictured with those gloves upon her hands, and for many yeeres after it was called the Earl of Oxford's perfume."

The old comedies of Elizabeth's time are full of allusions to oils, essences, quintessences, pomatums, perfumes, &c.

According to Haydn's *Dictionary of Dates*, no such trade as a perfumer was known in Scotland in 1763. A stamp tax was laid on various articles of perfumery in England, and the vendor was obliged to take out a license in 1786.

It is reported of Queen Elizabeth that her nasal organs were particularly fine, and that nothing offended her more than an unpleasant smell. The pommander became an article of luxury amongst people of rank; perfumed gloves were also fashionable, and the extensive use of perfumery at this period gave rise to numerous satirical observations by the authors of the day. As an indication of "the spirit of the times," at the latter part of the seventeenth century, I may here record that an Act of Parliament was introduced in 1770—

> "That all women of whatever age, rank, profession or degree, whether virgins, maids or widows, that shall from and after such Act impose upon, seduce, and betray into matrimony any of his Majesty's subjects by the scents, paints, cosmetic washes, artificial teeth, false hair, Spanish wool, iron stays, hoops, high-heeled shoes, bolstered hips, shall incur the penalty of the law now in force against witchcraft and like misdemeanours, and that the marriage, upon conviction, shall stand null and void."

In those days ladies had their private still-rooms, in which they manufactured their own perfumes.

Although it was chiefly from foreign countries that England obtained her supplies of perfumes, which have now become amongst us such a necessity to the toilet, it has been reserved for our generation to perfect the art of perfumery. For the last fifty years England has been distinguished for its manufactures, and with the aid of chemistry we are able now to fix the most fugitive odours, and offer them under a multitude of forms, the sweetness of which testifies the salubrity of their use.

In treating of the materials used in perfumery and their sources, I propose to give a few typical illustrations only.

The three kingdoms of Nature furnish raw material for the production of perfumes, but the vegetable kingdom excells in number, variety, and sweetness. From the animal kingdom we have ambergris, castor, civet, and musk.

Ambergris.—The origin of this substance was for a long time unknown, but it is now ascertained beyond doubt to be generated by the large-headed whale (*Pyseter macrocephalus*), and is the result of a diseased state of the animal. It is often found floating on the waters of the sea, or is washed ashore. It is found principally on the coasts of Greenland, Brazil, India, China, Japan, etc., and sometimes on the west coast of Ireland.

Castor is often secreted in a pocket that the beaver (*Castor fiber*) carries under the tail.

Civet is the glandular secretion of the *Viverra civetta*, an animal of the feline tribe, about three feet in length and one foot in height, which is found in Africa and India. Civet, in the natural state, has a most disgusting appearance, and its smell is equally repulsive to the uninitiated, who would be tempted to cry out with Cowper—

> "I cannot talk with civet in the room,
> A fine puss gentleman that's all perfume;
> The sight's enough, no need to smell a beau
> Who thrusts his nose into a raree show."

Yet, when properly diluted and combined with other scents, it produces a very pleasing effect, and possesses a much more floral fragrance than musk; indeed, it would be impossible to imitate some flowers without it.

Musk is a secretion found in secretory follicles under the belly of the musk deer (*Moschus moschiferus*), a ruminant which inhabits the higher mountain ranges of China, Thibet, and Tonquin. Musk is one of the strongest odoriferous substances, very lasting, and its odour adheres to all substances around it. It is rarely ever used alone. Its penetrating and tenaceous odour may affect the nerves, causing some persons to faint, and sometimes occasioning convulsions. It is so powerful that, according to Chardin's authority, the hunter is obliged to have his mouth and nose stopped with folds of linen when he cuts off the follicle from the animal, as otherwise the pungent smell would cause hæmorrhage, sometimes fatal. As, however, the natives take good care to adulterate it before they send it to Europe, we are not exposed to such accidents. Musk being mixed with other perfumes in very small quantities, loses its offensive smell and becomes agreeable to the olfactories.

The odour of musk is not confined to this species of animals but is recognised in many others—rats, birds, reptiles, and in some plants and insects.

These animal products, rarely used alone, enter into the fabrication of several compound perfumes, and are used mostly for toilet purposes.

The vegetable kingdom contains between sixty and seventy separate substances; these raw materials are capable of classification in various ways, according to the natural affinities of the plants yielding them, or the form and condition under which they are presented in commerce, or the nature and similarity of the odours they yield.

The odoriferous principles of plants may be divided into three kinds:—1. The essential oils, or ottos; 2, the camphors, balsams, resins; 3, the volatile ethers, similar to those which give their perfumes to wines and fruits. These principles, according to the plants, exist in flowers, leaves or fruits; sometimes in the trunk and bark, in the woods and roots. Thus, lavender, mint, thyme, etc., contain this principle in the leaves and stems; rose jasmin, violets, tuberose, etc., in the petals; patchouli, in the leaves; cinnamon, in the bark; anis, etc., in the seeds; orris, in the root; sandal and cedar in the wood. The different parts of the same plant sometimes afford different odours, as in the orange; and these various products take the form of essential oils or ottos, essences, waters, pomades, etc.

The separation of the principle of odours from its parent substance is the initial movement in most of the perfumer's operations. Natural essential oils form a group, the properties and chemical action of which are very variable. The processes yield light and heavy oils; of the former, oil of neroli is a type; and of the latter, oil of cloves is a type. Essential oil of almonds is obtained by reaction. There are, however, only two *flowers* to which this process of distillation is applicable—the rose and the orange blossom—the others being too delicate to withstand the great heat.

To secure the odours of flowers with fugitive odours, such as jonquil, *white* jasmin, tuberose and mignonette, the perfume of which is very difficult to fix, a process of absorption, called the cold *enfleurage* process, is employed—that is, they are placed in fat, and allowed to remain there in suitable vessels until the perfume has been fixed. Those flowers that are not equally sensitive, such as yellow jasmin, cassia, violets, hyacinth, etc., are submitted to a process of digestion, usually termed maceration; in this case the flowers are picked and placed in a mixture of melted fat, and after macerating a given time, the flowers are pressed out, and the infusions re-scented until the fat is sufficiently saturated to represent, according to purpose, a number six, twenty-four, or thirty-six pomade. From these pomades simple perfumes for the handkerchief are prepared, by macerating them in alcohol; the alcohol seizes the odoriferous molecules, and is afterwards filtered, when the fat, being insoluble in spirit, is left behind.

These pomades are the basis of all perfumes, and to these odorous solutions are added such ingredients as

Tonquin beans, Siam benzoin, vanilla, musk, and essential oils, to form compound perfumes or bouquets.

I told you that different natural odours could be obtained from the same plant. When orange flowers are treated by maceration, orange-flower pomatum is produced; when they are distilled with water, the otto neroli is obtained; the oily particles rise to the top and the oil is collected.

It is a remarkable fact that certain oils do not smell like the flowers which yield them. Oil of neroli, for instance, resembles the smell of fresh-water fish, but in the *enfleurage* process the neroli assumes the *exact* odour of the flower. In this process there is no elimination of watery vapour to destroy the essence.

By distilling the *leaves* of the same plant, another otto is obtained—oil of petit gram.

Orange-flower water is obtained by placing the flowers in a still with water; the water comes over, having absorbed as much of the perfume as it will hold in solution. Oil of Portugal is obtained from the *rind* of the green orange, by a process called expression.

Compound perfumes are the results of careful education in the construction of odours, and it frequently happens that the names given to these perfumes are not any indication of the composition. For instance, Eau-de-Cologne is not produced from a production of Cologne itself. The ingredients entering into its composition come from the South of France and Italy, and it can be made just as well anywhere else as at Cologne. Its perfume is extracted principally from the flowers, leaves, and rind of the fruit of the bitter orange. To come near home, "Mona Bouquet, distilled from Mona's choicest flowers," is produced from animal and vegetable substances, collected from different parts of the world, and not from any flowers produced in the Isle of Man. But in this case the art of the manufacturer has been so successful that an exquisite and popular perfume is the result.

It happens in some cases that certain flowers are too delicate, or not collected in sufficient quantities, to enable the manufacturer to produce the natural odour with a satisfactory pecuniary result. In such instances we have to put up with imitations by combination of natural odours of plants. As an instance, the delicate heliotrope, which gives a fragrance so well known to Englishmen, as it is plentiful in our gardens, is so fugitive that the collection of its fragrant molecules by ordinary means is unprofitable to the perfumer, and it is not obtainable; but all the essence of heliotrope sold and accepted by mankind as the natural odour, is a combination of vanilla, rose, orange flowers, ambergris, and almonds. It is a fact, perhaps worth recording here, that the only natural odour which resists the artifice of the perfumer to imitate to perfection is jasmin.

The sweetest flowers, the perfumes, and generally all aromatic substances, are produced in Eastern countries, but the chief sources from which we derive perfumes are the South of France, Turkey, Italy, Spain, and the Mediterranean coast of Africa. The flower farms at Grasse and Nimes are most luxuriant, and these are the chief places of production, for plants, etc., not grown there, or their products, are imported by the manufacturers. Algeria has latterly developed a most important industry of this nature, rose geranium being specially luxuriant there. Our own country only furnishes one natural *perfume* in perfection; at Mitcham, in Surrey, and Hitchin, in Hertfordshire, lavender is produced very largely, or I should say was produced, for recently the production has fallen off. Fine old English lavender water is a very favourite perfume.

> "In each bright drop there is a spell,
> 'Tis from the soil we love so well,
> From English gardens mown."

Our climate appears to be better adapted for the perfect development of lavender; our humid atmosphere tones down or softens the natural rankness of the odour of the essential oil. Very large quantities are grown in the Alps Maritimes, France, and Algeria, which is remarkably good, but when I tell you that the finest French oil has only a commercial value of 9s. per lb., against 200s. per lb. for English, and that some French oil produced in the Spike district may be obtained as low as one shilling per lb., you may judge of the value set upon *our* natural perfume.

Odours of the Earths.—All those materials which are distinguished in ordinary conversation as earths, give out a peculiar and characteristic odour immediately they are wetted with water. Every pedestrian on the high-road in the country, during the summer months, being caught in a shower, must have remarked the delightful fragrance that fills the air a few minutes after the rain has fallen, and then passes away.

The disengagement of these odours from the earth is owing to the presence of organic matters, or of odorous gases absorbed by porous earths, and displaced by water.

Artificial Odours and Flavours.—There is only one substance which the *perfumer* places in his category as produced in the laboratory of the chemist. In 1845, Hoffman discovered that benzole could be easily prepared in enormous quantities from coal tar, and the series of investigations which this chemist then carried out gave first the artificial oil of almonds, nitro benzole (largely employed in the manufacture of so-called almond soap), as a commercial product, and later, the infinitely more valuable series of coal tar products which have now revolutionised the art of the dyer and other industries. Since Hoffman's investigations we have also produced, by chemical decompositions, cumarin, the odorous principle of Tonquin beans, vanillin of vanilla, and heliotropene of heliotrope, but *these* artificial productions are of little or no value to the perfumer.

Chemical analysis has found in the composition of some perfumes real organic ethers—for instance, the odour from geranium is said to be due to the presence of pelargonic ether; synthesis, realising the direct production of these same ethers, has taught the chemist to prepare them in such a state of purity, that it is easy to confound them, by their physical properties, with the natural perfumes. Two distinguished chemists, members of the jury in the Great Exhibition of 1851, Dr. Hoffman and Mr. De la Rue, ascertained that some of the most delicate perfumes were made by chemical artifice and not as of old from the natural flowers. Singularly enough, some odours, or I should prefer to say flavours are derived from substances of intensely disgusting odour, and we can by certain admixtures produce artificial fruit essences, quite innocuous in the proportion in which they are used by confectioners, viz., a drop and a half to one ounce.

The introduction of these artificial fruit essences originated in the discovery of the fact that the peculiar flavour of pine-apple rum was due to butyric ether, which has since been obtained from the fruit itself. Artificial oil of pine apples is the product of the action of rotton cheese on sugar, and distilling it with alcohol and sulphuric acid.

Many of us can call to mind the intolerable smell of rotten apples. In the manufacture of valerianic acid another chemist found the same smell, and practical men have discovered by which choice and combination it is possible to imitate the odour of particular fruits to such a nicety, as to make it probable that the odour of the fruit is owing to a natural combination identical to that produced by art, so much so that the chemist is enabled to produce from fruits the same combinations. The basis of the majority of these essences is a peculiar fetid oil, termed fusel oil (hydrate of the oxide of amyl), formed in the distillation of brandy and whiskey. This oil distilled with sulphuric acid and acetate of potash gives oil of pears.

In illustrating these facts experimentally I would observe that the construction of the artificial fruit flavours as given in text-books, is not reliable, their actual composition being the result of patient investigations by the various manufacturers, and not generally revealed by them.

COLOUR HARMONY.

BY G. H. MORTON, JUN.

HARMONY of colour consists in the three colour sensations being equally excited, either jointly or separately, by all the colours of a composition, the mean, or general, tone of which will consequently be some shade of white. It therefore appears only necessary to ascertain the relative proportions of the three fundamental colours in order to obtain a correct basis of harmony.

The subject of colour, however, has two sides—the scientific and the artistic. Physicists have proved that the three primary sensations are scarlet, green, and violet, while most artists still support the old theory that the three primary pigments are crimson, yellow, and blue. It has therefore to be determined in the first place, which of the two sets is correct, or are both?

Admitting that scarlet, green, and violet are the three primary sensations, because supported by Helmholtz, Tyndall, and, I think, by all modern physicists, we have to inquire upon what foundation the crimson, yellow, and blue theory rests, and what relation these colours bear to scarlet, green, and violet.

We cannot obtain any of the colours of the primary pigments by mixture, but conversely almost all other colours are obtained from them. The particular hues of red, yellow, and blue, which mix best with the greatest number of other pigments, are a crimson red, a yellow neither green nor orange, and a blue of a greener hue than is often implied by that term. Crimson, yellow, and blue have therefore been named primary colours.

Each of these colours appears to have the power of exciting two primary sensations, and is therefore complimentary to the third. Crimson excites violet and scarlet, and is complimentary to green. Yellow excites scarlet and green, and is complimentary to violet. Blue excites green and violet, and is complimentary to scarlet. Colours approximating to the primary sensations may be obtained by combining two primary pigments. This relationship of the two sets proves that the primary colour sensations are equally excited in both sets, and will be best shown as follows:—

Primary Colours.

Pigments.				*Sensations.*
1 Crimson	=	½ Scarlet ½ Violet	=	1 Scarlet.
1 Yellow	=	½ Green ½ Scarlet		1 Green.
1 Blue	=	½ Green ½ Violet		1 Violet.

It will be seen that harmony of colour being produced by scarlet, green, and violet, will also be produced by crimson, yellow, and blue, and that whether we adopt the scientific or the artistic theory as a basis for colour schemes, our results as to harmony will be the same—providing the pigments we employ are combined in a scientific manner, as colour.

True combinations of colours, as components of white light, can seldom be obtained in the ordinary way by mixing pigments together. One of the most convenient methods for colourists is by a rotating disc, on which the colours are placed. The disc is then revolved rapidly till the colours appear blended. By this means the following results are obtained:—Scarlet and green produce yellow; scarlet and violet, light-crimson or pink; green and violet, blue; yellow and blue, grey. These results differ considerably from the colours generally obtained by mixture, and I think sufficiently prove the errors caused by combining colours as pigments, and not as components of white light.

Proportion in colour harmony is of much importance. Until recently the theory was that, dividing white light into sixteen parts, the proportions of yellow three, red five, blue eight, would be obtained; and no composition was considered harmonious unless these colours were present, either pure or combined, in these particular quantities.

Professor Rood, however, in a work entitled *Modern Chromatics*, gives an almost opposite hypothesis, and his calculations are especially valuable from the fact that, in addition to his being a professor of physics, he is also a practical artist, and therefore conversant with both sides of this subject. To go over his calculations would be tedious and occupy much time; but having abstracted crimson, yellow, and blue from some twelve colours he enumerates, I find that their proportions in white light are respectively about four, seven, five; quantities, especially as regards yellow and blue, almost the reverse of what they were formerly considered to be.

Colour harmony is sometimes divided into two parts. Chevreul divides it into harmony of contrast and harmony of analogy.

Strictly speaking, there can be no such thing, in colour, as harmony of analogy, because all true harmonies, when reduced to their simplest form, contain the greatest possible contrasts.

Chevreul subdivides analogy into three parts, and names them harmonies of scale, of hue, and of a dominant coloured light. The first is produced by different tones or shades of the same colour only being employed. Such a scheme, it is scarcely necessary to point out, would not be harmonious. The more saturated or intense the colour, the worse would be the effect, for any colour when lightened necessarily brings in a portion of the remaining colours, by which it is neutralised, with the white introduced—hence all light tones of colours are more or less satisfactory. Shades of a colour are also not unpleasing from the fact that much of the colour is absorbed by the black. An instance of this so-called harmony was demonstrated a year or two ago in the adoption of very dull colours in decoration and dress. In such schemes proper harmony seldom existed, but discord was hidden by the introduction of so much black or grey.

Chevreul's harmony of analogy of hue is produced by any colours of analogous tones or shades, and may therefore include colours which constitute true harmony.

An analogous effect by a dominant colour, Chevreul's third harmony, results from one colour being added to all the others in the composition. It can, perhaps, best be realised by viewing a scheme through coloured glass; the colour of the glass seems to pervade everything. A deep red sunset scene is also an example, red being the dominant colour.

The prismatic image illustrates an analogous arrangement of harmonious colours. Beginning at the red end we have crimson, scarlet, orange, yellow, green, blue, and violet, with the most delicate hues between, so that where one begins or ends we cannot tell. All the contiguous colours, so to speak, are analogous, and yet the whole includes the greatest possible contrasts.

It may, I think, be concluded that analogy is the method by which contrasting colours should be connected, and not placed in violent opposition, and in this sense may be included in the term harmony, but is incomplete in itself.

Analogous colour schemes have lately been termed "tone harmonies," by modern colourists, owing to the late prevalence of dull tints—tints, in many cases, in which little colour is visible at all. The harmony, as the term implies, is of tone, and not of colour.

Mr. C. W. Dempsey, in an article in the *Magazine of Art*, about three years ago, stated that Mr. Morris, in decoration, and Mr. Whistler, in painting, were among the chief exponents of "tone harmonies," and the success achieved by them was well known. But Mr. Morris appears, to me, to be now more inclined to contrast, or, at least, to more distinct and definite colour. Mr. Whistler seems as peculiar as ever, his recent "arrangement" being proof enough.*

In the article referred to, the two sides of colour—the science of colour and the art of colouring, and the technical meanings of the principal terms in both—are pointed out; these terms are harmony and melody.

Harmony I have already defined, and Mr. Dempsey defines melody as "two or more colours in such juxtaposition that they form a part, or the whole of the prismatic spectrum, whether in their natural direct order or inverted." Melody, then, seems to be another term for the so-called harmony of analogy, and a better one, because it does not confound two meanings in one word, and is applied to the art of colouring, whereas harmony is applied to the science of colour. Both terms are compatible, for when harmony is obtained by melodious means our compositions are then perfect.

It has been argued that there are two schools of colourists. First, that of harmonious contrast; second, that of melodious intervals; but melody appears to be the proper manner of arranging harmonious colours, in the same way that harmonious notes are uninteresting till a melody is composed. Melody in one colour is to some extent similar to playing on one note.

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* "Arrangement in yellow and white," Fine Art Society's Rooms, 1883.

This being the case, how is it that so many apparently inharmonious compositions have been successful? There are many reasons, mostly unrecognised or unthought of. Many rooms have been decorated entirely in dull greens or blue greens, but contiguous rooms may be in hues of yellows and brown, consequently the two apartments together would be harmonious, separately melodious; indeed, our colour appreciation would be momentarily increased on passing from one room to the other. Then furniture and art objects generally bring in some contrasting colours. The chief cause, however, is due to the low key in which the large surfaces were coloured, the actual amount of pure colour being very small, the greater portion being grey in which the three primaries are present in harmonious proportion. It is seldom, perhaps never, that the three primary colours are absent in decoration, taken as a whole, and including carpets, furniture, everything. All in the room, and all that can be viewed out of the room, must be taken account of, as also the amount of light received into it, and the colour of that light. A room decorated in melodious tones of reds, in which no opposite colours were permitted, having a large window looking out upon a green lawn, might be strictly harmonious in daylight, though at night, when the green was shut out, the impression would doubtless be hot and oppressive.

It would appear that the older colourists adopted harmony, the presence of the three primary colours, either pure or in combination, in certain relative proportions, as a rule not to be violated; but they often neglected the subtle melody by which means melodious harmony is most successfully arrived at. Hence their schemes are inclined to be crude and unrefined. The foundation upon which they worked, as to colour, but probably not as to proportion, was correct. They worked under the delusion that the contrast of pure primary and secondary colours, because harmonious, were beautiful; that bright red and bright green, or bright blue and bright orange, when contrasted, produced perfect composition. It is needless to say that such would be extremely vulgar, unless melodiously arranged either by tones or shades, or by those intermediate hues which would melodiously connect them, or by both.

On the other hand, the tendency of modern colourists, of the so-called melodious school, is to neglect harmony, which should be the foundation of their ideas; mistaking the method for the fact, and producing effects at first pleasing, but eventually becoming tiresome and wearying.

It may therefore be concluded that harmony and melody are essential in the art of colouring. The scientific fact that white light causes three principal colour sensations, all of which must be equally excited, otherwise the eye gets wearied and probably injured, must not be neglected. These three sensations are, as it were, the harmonious notes of colour, the art of composing them may be termed colour melody.

METAMORPHOSES

OF

BRAZILIAN LEPIDOPTERA

FROM SAN PAULO, BRAZIL.

SECOND SERIES.

BY

E. DUKINFIELD JONES, C.E.,

CORRESPONDING MEMBER LIT. AND PHIL. SOC., L'POOL.

WITH NOMENCLATURE AND DESCRIPTIONS OF NEW FORMS.

By FREDERIC MOORE, F.Z.S.

INTRODUCTORY NOTE.

The following paper is a continuation of the one communicated to this Society in November, 1881, and is a description of the metamorphoses of twenty-eight species of Brazilian Lepidoptera, illustrated by specimens, which specimens I have had very great pleasure in presenting to the Liverpool Free Public Museum.

I regret that this series is not so complete as the former one; in many cases the larva or pupa is wanting, either from the fact that I only found one specimen of the larva, and so was not able to preserve the insect in the three stages, or from my having mislaid some of the pupæ on leaving San Paulo. For, unfortunately, I find several pupæ that I thought I had with me are missing. However, on consulting Mr. T. J. Moore, the Curator of the Museum, as to whether I should describe only those species that I have in all three stages, and leave the others until completed at some future date, he replied, "A bird in the hand is worth two in the bush;" and on that principle I have given the descriptions of some species whose life-history I have really worked out, but which are not yet represented in the collection by examples of each state, hoping to have at some future time the good fortune of obtaining specimens to make each species complete.

The critical determination of the species contained in this second collection, as in the first, has, at the recommendation of the Rev. H. H. Higgins, been intrusted by the Library and Museum Committee to Mr. Frederic Moore.

E. D. J.

30th April, 1883.

SYSTEMATIC ARRANGEMENT.

RHOPALOCERA.

Family NYMPHALIDÆ.

Subfam. *Danainæ.*

(Group DANAOID HELICONINA).

LXX.—Sais Euryanassa.

Subfam. *Acræninæ.*

LXXVI.—Actinote Alalia.

Subfam. *Nymphalinæ.*

LXVI.—Dione Juno.
XLIII.—Dione Vanillæ.
LXXI.—Pyrameis Braziliensis, n. sp.
XXII.—Ageronia ferentina.
VIII.—Heterochroa Syma, var.
XCIV. Siderone Isidora.

Family PAPILIONIDÆ.

Subfam. *Pierinæ.*

LXXXIV.—Synchloe Monuste.
LXXXVI.—Leptophobia Aripa.

Subfam. *Papilioninæ.*

LXV.—Papilio Bunichus.
LXXVII.—Papilio Polydamas.
LXXXIII.—Papilio Protodamas.

HETEROCERA.

Family SPHINGIDÆ.

XCV.—Philampelus Vitis.
V.—Philampelus Anchemolus.
LXXXV.—Amphonyx Tapayusa, n. sp.

Family ZYGÆNIDÆ.

XIV.—Saurita Cassandra.

Family NOTODONTIDÆ.

XCIII.—Aneurocampa Mingens.

Family PSYCHIDÆ.

LVIII.—Genus ————?

Family SATURNIIDÆ.

XXVI.—Automeris illustris.
XVIII.—Automeris ophthalmica, n. sp.
C.—Attacus Arethusia.
XLVII.—Attacus Jacobææ.

Family LASIOCAMPIDÆ.

XLIV.—Syssisphinx Molina.
XC.—Mesotages trilunula.
XXXIX.—Megalopyge fuliginosa, n. sp.
LXIV.—Hyleria falcifera.

Family TINEIDÆ.

XCVII.—Endrosis Braziliensis, n. sp.

The above arrangement includes only those species which are enumerated in this paper. In the following page they are incorporated with the species contained in the previous collection, as given in the Proceedings of the Society for 1881–2, p. 331.

F. MOORE.

COMBINED SYSTEMATIC ARRANGEMENT
OF
MR. DUKINFIELD JONES' FIRST AND SECOND COLLECTIONS
OF
BRAZILIAN LEPIDOPTERA.

RHOPALOCERA.

Family NYMPHALIDÆ.

Subfam. *Danainæ.*

LXII.—Danais Erippus.

(Group DANAOID HELICONINA).

LXX.—Sais Euryanassa.
XXV.—Mechanitis Lysimnia.

Subfam. *Morphinæ.*

XLI.—Morpho Hercules.
III.— „ Epistrophis.

Subfam. *Brassolinæ.*

XXXIV.—Brassolis Astyra.
XIX.—Opsiphanes Glycerie.

Subfam. *Acræinæ.*

XV.—Acræa Pellenea.
LXXVI.—Actinote Alalia.
LXXXII.—Actinote Alalia, var.

Subfam. *Heliconiinæ.*

LXIX.—Eueides Dianasa.

Subfam. *Nymphalinæ.*

LXVI.—Dione Juno.
XLIII.— „ Vanillæ.
LXXI.—Pyrameis Braziliensis.
LIII.—Junonia Cænia.
VII.—Ageronia Amphinome.
XXII.— „ ferentina.
VIII.—Heterochroa Syma.
XCIV.—Siderone Isidora.

Family PAPILIONIDÆ.

Subfam. *Pierinæ.*

XXIV.—Catopsilia Philea.
LXXXIV.—Synchloe Monuste.
LXXXVI.—Leptophobia Aripa.

Subfam. *Papilionæ.*

XXXI.—Papilio Thoas.
XLV.— „ Grayi.
XXXVIII.—Papilio Evander.
XLII.— „ Lysithous.
LXV.— „ Bunichus.
LXXVII. „ Polydamas.
LXXXIII. „ Protodamas.

Family HESPERIIDÆ.

XXI.—Pyrrhopyga Palemon.
LIV.—Goniuris Proteus.

HETEROCERA.

Family SPHINGIDÆ.

XCV.—Philampelus Vitis.
V. „ Anchemolus.
LV.—Dilophonota Ello.
LXI.—Argeus Labruscæ.
LXXXV.—Amphonyx Tapayusa.
XXVIII.—Pachylia inornata.
XIII.—Sorocaba anomala.

Family ZYGÆNIDÆ.

XIV.—Saurita Cassandra.

Family CHALCOSIIDÆ.

LXXII.—Phæochlæna tendinosa.

Family ARCTIIDÆ.

XXX.—Daritis sacrifica.
XLVI.—Motada lateralis.

Family PSYCHIDÆ.

LVIII.—Genus ?
XXXIII.—Perophora albistriga.
IX.— „ externa.

Family NOTODONTIDÆ.

XXIX.—Aneurocampa lateralis.
XCIII.— „ Mingens.

Family SATURNIIDÆ.

I.—Automeris sp.?
II.— „ Metea.
XXVI.— „ illustris.
XVIII.—„ ophthalmica.
XX.—Molippa Sabina.
LXXV.—Arsenura erythrinæ.
LX.—Attacus Aurota.
C.— „ Arethusia.
XLVII.—Attacus Jacobææ.

Family LIMACODIDÆ.

LXVII.—Pinconia ochracea.
LXXX.—Neomiressa argentata.
LXXIX.—Narosa rufotessellata.

Family LASIOCAMPIDÆ.

IV.—Eacles Laocoon.
XLIV.—Syssisphinx Molina.
XVII.—Megalopyge Citri.

Family LASIOCAMPIDÆ—*continued.*

XXXV.—Megalopyge dorsimacula.
LXXXI.— „ sp.?
XL.— „ Tharops.
XXXIX.— „ fuliginosa.
XC.—Mesotages trilunula.
LXIV.—Hyleria falcifera.
XXVII.—Hydrias Deusta.

Family GLOTTULIDÆ.

LVII.—Cabralia trifasciata.

Family APAMIIDÆ.

L.—Prodenia Commelinæ.
„ variolosa.

Family CALPIDÆ.

LII.—Gonodonta fulvangula.

Family REMIGIIDÆ.

LI.—Remigia mensuralis.

Family TINEIDÆ.

XCVII.—Endrosis Braziliensis.

F. MOORE.

Plate VII.

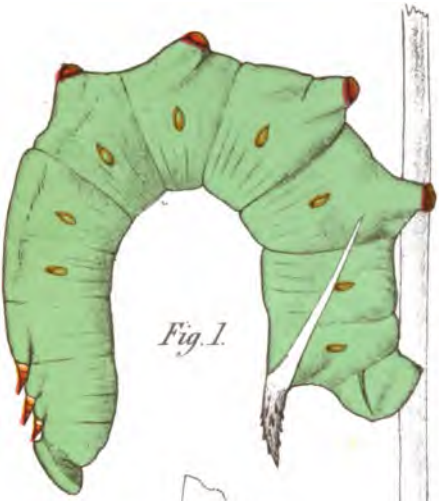

Fig. 1.

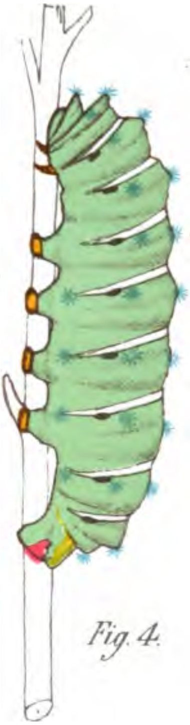

Fig. 4.

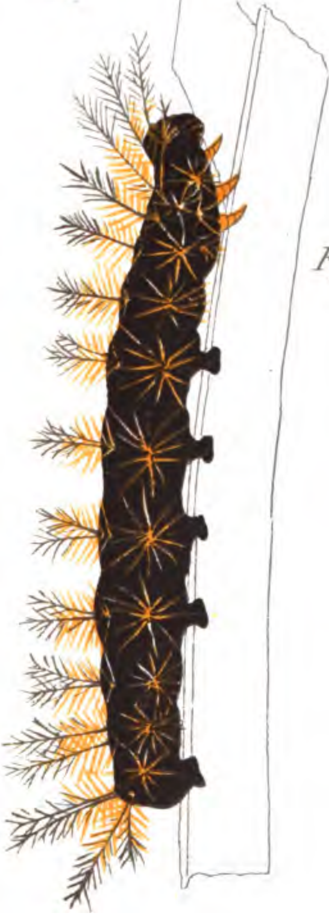

Fig. 3.

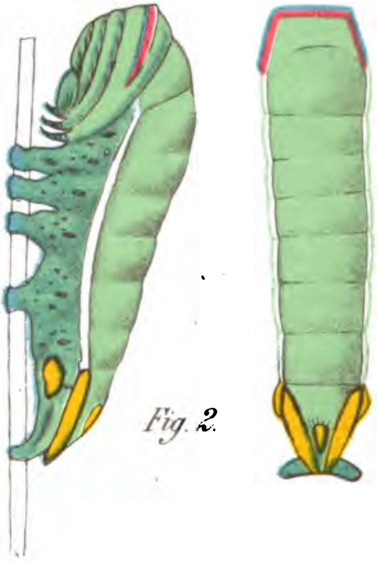

Fig. 2.

E. D. JONES.

METAMORPHOSES OF BRAZILIAN LEPIDOPTERA.

RHOPALOCERA.

Family NYMPHALIDÆ.

Subfam. *Danainæ.*

Group DANAOID HELICONINA.

Genus SAIS. Hübner.

LXX.—SAIS EURYANASSA.

Ithomia Euryanassa, Felder, Wien. Ent. Monats. iv., p. 101 (1860) : Reise, Novara, Lep. 11., pl. 44., f. 1.

LARVA. Full-fed. San Paulo, 16th June, 1881.

The caterpillars of this species are found in great quantities on the leaves of a species of Datura, the eggs being deposited in clusters of about two hundred on the underside of the leaves. The caterpillar is quite smooth, with a velvety black skin and a red head.

PUPA. {Full-fed, 16th June, 1881.
Imago, 6th July, 1881.} 20 days.

When full-fed the caterpillar becomes suffused with a greenish tint, and hangs itself up by the tail to undergo pupation. The chrysalis is a very compact and neat one. It is of a semi-transparent brown colour, thickly dotted with black.

IMAGO. {Full-fed, 16th June, 1881.
Imago, 6th July, 1881.} 20 days.

The very delicate and beautiful butterfly appears three weeks after pupation. It is a common fly in San Paulo, and is often seen in the streets of the town, where it has probably been reared in some garden at the backs of the houses. There are several broods in the year.

Subfam. *Acræinæ.*

Genus ACTINOTE. Hübner.

LXXVI.—ACTINOTE ALALIA.

Acræa Alalia, Felder, Wien. Ent. Monat. iv., p. 105 (1860).

LARVA. Full-fed, San Paulo, 28th October, 1881.

The caterpillar feeds upon a shrub, the name of which I do not know. I have taken it in the forest on the Serra da Cantareira, near San Paulo. It is of a pale bluish colour, and is thickly covered with spines, which apparently have no venomous properties.

PUPA. Not preserved.

The caterpillar hangs itself up by the tail to undergo pupation. The chrysalis is of a creamy white colour, ornamented with black veins and a double row of black spines on the back.

IMAGO.	*a*, ♂	Full-fed, 28th Oct., 1881. Imago, 16th Nov., 1881.	19 days.
	b, ♀	Full-fed, 28th Oct., 1881. Imago, 16th Nov., 1881.	19 days.

The butterfly emerges in a little under three weeks from the time of pupation.

[NOTE.—A variety of this species, reared by Mr. Dukinfield Jones, is described in the former paper, published in the Proc. of the Lit. and Phil. Soc. of Liverpool, 1881–2, p. 340, No. LXXXII.]

Subfam. *Nymphalinæ.*

Genus DIONE. Hübner.

Syn. *Agraulis.* Boisd., Doubleday.

LXVI.—DIONE JUNO.

Papilio Juno, Cramer, Pap. Exot. 111., pl. 215, f. B.C. (1782).

LARVA. Full-fed, San Paulo, 21st April, 1880.

The caterpillar feeds on a species of Passion-flower, and is often found in company with No. XLIII, *Dione Vanillæ,* var. It is more social in its habits than the latter species, and may be taken in clusters of a dozen or so on a single leaf. It is of a dark brown colour, and is covered with spines.

PUPA. Full-fed, 21st April, 1880. } 21 days.
Imago, 12th May, 1880.

When about to undergo pupation the caterpillar attaches itself by the tail to the stalk of the food-plant, the coping of a wall, or other convenient spot.

IMAGO. Full-fed, 21st April, 1880. } 21 days.
Imago, 12th May, 1880.

The butterfly emerges three weeks after pupation.

XLIII.—DIONE VANILLÆ (variety).

Papilio Vanillæ, Linn. Syst. Nat. i., 2, p. 787 (1767).
Cramer, Pap. Exot. iii., pl. 212, fig. A.B.

LARVA. Full-fed, San Paulo, 14th April, 1880.

The caterpillar of this insect feeds upon the leaves of a Passion-flower that is common in the neighbourhood of San Paulo. It is of a pale brown colour, with dark longitudinal stripes down the back, and is covered with horny spines.

PUPA. Full-fed, 14th April, 1880.

When full-fed the caterpillar wanders away from the food-plant, and seeks a convenient spot, such as the coping of a wall or other protected situation, where it suspends itself by the tail and undergoes pupation.

IMAGO. { *a*, Upper side, Full-fed, 15th Ap., 1880. } 17 days.
Imago, 2nd May, 1880.
b, Under side, Full-fed, 14th Ap., 1880. } 16 days.
Imago, 30th April, 1880.

This beautiful butterfly is very common; in fact, it is one of the commonest about San Paulo. It emerges from the chrysalis sixteen days after the caterpillar is full-fed.

Genus PYRAMEIS. Hübner.

LXXI.—PYRAMEIS BRAZILIENSIS, n. sp.

Pyrameis Braziliensis, n. sp.:—Forewing with the basal area golden-brown, from thence to the apex purplish-black; obliquely across the disc is a series of bright red spots, two of which are in the middle of the cell, and form an irregular-shaped letter S, the ends of which are very broad, and the outer end tipped with white at its external angle; two small conjoined spots are beyond lower end of the cell, followed by a quadrate spot centred with a white dot; below these is a larger oblique quadrate spot, followed by a small spot near the posterior angle; beyond the end of the cell is a transverse white streak crossed by black veins, and near the apex is a transverse series of four small spots, the upper and lower of which are white, the two middle ones being minute and bluish-white; beyond these is a submarginal lunular line, the upper end of which is purplish-white and the lower end pale brown. Hindwing with a purplish-black basal mark, a discal centrally-angled band and a distinct submarginal lunular band, these bands enclosing two ocellated spots and an intermediate black dot; along the extreme outer margin is a row of black angular spots. Cilia alternated with white. Body golden-brown. Expanse 2 to 2¼ inches.

[NOTE.—*Pyrameis Myrinna*, a very distinct species from the above, was also collected by Mr. Dukinfield Jones in the same locality as *P. Braziliensis*, but its metamorphoses not having been worked out, the specimens remain in his private collection.—F. MOORE.]

Larva. Not preserved.

a, b. Nests made by larva amongst flowers of food-plant.

The caterpillar is of a silvery grey colour, with bands of dark brown round the segments, which are covered with long spines. The food-plant is a kind of "everlasting flower," called by the Brazilians "Marcello," the flowers of which are dried and used for stuffing pillows. The caterpillars are solitary, only one or two being found on the same plant; and in the earlier stages they make a sort of nest amongst the flowers, into which they retire when not feeding.

Pupa. { Full-fed, 20th April, 1880.
Imago, 24th May, ,, } 34 days.

When full-fed the caterpillar suspends itself by the tail, and in that position changes to the pupa state.

Imago. { *a,* Upper side. Full-fed, 20th Ap., 1880.
Imago, 24th May, ,, } 34 days.
b, Under side.

The butterfly appears five weeks after the larva is full-fed. In its habits it somewhat resembles Junonia, delighting in sunning itself on bare patches of ground in the Campos.

Genus AGERONIA. Hübner.

XXII.—AGERONIA FERENTINA.

Nymphalis ferentina, Godart, Enc. Meth. ix., p. 428 (1823).

Larva. *a,* Full-fed. San Paulo, March, 1878.

The caterpillar feeds on the same plant, or closely allied species, as No. VII (*Ageronia Amphinome*). It is of a grey colour, and is covered with horny spines, with two large horns on the head. It is smaller than *A. Amphinome*, and has not the same restless habits.

PUPA. a, Full-fed, 6th March, 1878.
Imago, 16th „ „ } 10 days.

When full-fed the caterpillar hangs itself up by the tail to undergo pupation, the pupa state lasting ten days.

IMAGO. a, Full-fed, 6th March, 1878.
Imago, 16th „ „ } 10 days.

The butterfly is common in the neighbourhood of San Paulo. In its habits it closely resembles *A. Amphinome*, settling on the trunks of trees with the head downwards and the wings spread out against the bark. From its resting-place it every now and then takes short flights after passing friends, circling round and making a noise like a series of electric sparks.

Genus HETEROCHROA. Boisd.

VIII.—HETEROCHROA SYMA (variety).

Nymphalis Syma, Godart, Enc. Meth. ix., p. 374 (1823).
Hübner, Zutr. Exot. Schmett, fig. 571–2.

LARVA. *a*, Full-fed, San Paulo, 1882.

The caterpillar feeds on a species of bramble, and is of a dark green colour, covered with protuberances with spines at the ends. When not eating, it rests with the thorax raised and the head bent down, giving it a very grotesque appearance. When full-fed the colour changes to a dull yellowish brown.

PUPA. *a*, Empty shells, Full-fed, 21st Feb., 1878.
Imago, 6th March, „ } 13 days.
b, In spirit, Full-fed, 8th April, 1878.

The caterpillar hangs itself up by the tail on the underside of a leaf or other suitable spot, to undergo pupation. The pupa condition lasts about a fortnight.

Imago. { *a*, Upper side.
b, Under side, Full-fed, 2nd Dec., 1881. } 12 days.
Imago, 14th Dec., „ }

This butterfly is very common in the neighbourhood of San Paulo, especially at the edges of swamps and similar situations. Its flight is like that of the *Vanessidæ*, a few sharp vigorous strokes, and then a gliding motion, with the wings almost horizontal. There appear to be many broods of this species in the year, as I have found the full-fed caterpillar in February, April, October, and December.

Genus Siderone. Hübner.

XCIV.—Siderone Isidora.

Papilio Isidora, Cramer, Pap. Exot. iii., pl. 235, fig. A. B. E. F. (1782).

Larva. Not preserved.

I took only one specimen of this caterpillar full-fed on 23rd December, 1881. It had already left its food-plant, and was searching for a suitable place for pupation. The caterpillar is smoke colour, and has two fleshy protuberances on the thorax and a pair of horns on the head.

Pupa. { Full-fed, 23rd Dec., 1881. } 15 days.
Imago, 7th Jan., 1882. }

On December 24th the caterpillar suspended itself by the tail, and pupation took place on the 26th.

Imago. { Full-fed, 23rd Dec., 1881. } 15 days.
Imago, 7th Jan., 1882. }

The curious butterfly appeared a fortnight after the caterpillar was full-fed. When at rest it closes the wings together, and stands head downwards on the trunk of a tree, in which position it has a remarkable resemblance to a dry leaf.

Family Papilionidæ.

Subfam. *Pierinæ.*

Genus Synchloe. Hübner.

LXXXIV.—Synchloe Monuste.

Papilio Monuste, Linn. Syst. Nat. i. 2, p. 760 (1767).
Cramer, Pap. Exot. ii., pl. 141, fig. F.

Ova. On Nasturtium leaf, San Paulo, March, 1881.

The eggs are laid in clusters of about fifty; on the upper side of the leaf of the food-plant. Time of incubation not determined.

Larva.	Hatched,	21st	March,	1881.
	Changed skin,	25th	,,	,,
	,,	27th	,,	,,
	,,	29th	,,	,,
	,,	1st	April,	,,
	Full-fed,	6th	,,	,,

The caterpillar feeds on Nasturtium, and is of a pale-green colour, covered with minute purple tubercles.

Pupa.	Full-fed, 6th April, 1881.	14 days.
	Imago, 20th ,, ,,	

The caterpillar attaches itself by the tail, and a loop round the thorax, to a wall, paling, &c., to undergo pupation.

Imago.	Full-fed, 6th April.	14 days.
	Imago, 20th ,,	

The butterfly appears a fortnight after the caterpillar is full-fed.

Genus Leptophobia. Butler.

LXXXVI.—Leptophobia Aripa.

Pieris Aripa, Boisd. Spec. Gén. Lep. i., p. 528 (1836).

Larva. Full-fed. San Paulo, 26th March, 1881.

The caterpillar is green, and feeds on Nasturtium. I took it full-fed at the end of March, 1881.

Pupa. Not preserved.

The caterpillar fixes itself by the tail, and a loop round the thorax, for pupation.

Imago. { Full-fed, 26th March, 1881.
Imago, 6th April ,, } 11 days.

The dormant period is remarkably short in this species, the butterfly appearing eleven days after the caterpillar is full-fed.

Subfam. *Papilioninæ.*

Genus Papilio. Linn.

LXV.—Papilio Bunichus.

Menelaides Bunichus, Hübner, Samml. Exot. Schmett.
Papilio Bunichus, Boisd. Spec. Gén. Lep. i., p. 308.

Larva. Full-fed. San Paulo, 4th Dec., 1877.

This caterpillar feeds upon a species of Aristolochia. It is covered with soft fleshy protuberances, and has a V-shaped scent organ on the first segment, which is protruded when annoyed. The colour is almost black, with a reddish tinge, and there is a creamy-white diagonal stripe, beginning on the sixth and ending on the protuberance on the seventh segment.

Pupa. { Full-fed, 10th March, 1880.
Imago 30th ,, ,, } 20 days.

When full-fed the caterpillar attaches itself by the tail and a thread round the thorax, to the underside of a branch of a tree or the coping of a wall, or other similar situation, and in that position undergoes pupation.

IMAGO. { *a*, ♂
b, ♀ Full-fed, 10th March, 1880. } 20 days.
Imago 30th „ „

The butterfly emerges three weeks after pupation. It is a very common species, and there are several broods in the year, fresh specimens having been taken in the spring (August and September), being one of the earliest of the larger butterflies that appears after the cold season, and also in December, and again in March and April.

LXXVII.—PAPILIO POLYDAMAS.

Papilio Polydamas, Linn. Syst. Nat. i. 2, p. 747 (1767).
Drury, Exot. Ent. i., pl. 17, fig. 1, 2.

LARVA. Full-fed. San Paulo, Oct., 1881.

This caterpillar feeds upon a species of Aristolochia that is a rare plant in the neighbourhood of San Paulo, and consequently the caterpillar is rare also. It is of a smoky brown colour, marked with numerous diagonal dark stripes, and is covered with short and slender fleshy protuberances. On the first and tenth segments the lateral protuberances are movable, and the caterpillar twitches them up and down in an odd way as it walks. There is a V-shaped scent organ on the pro-thoracic segment that is exserted when the insect is annoyed.

PUPA. { *a*, Full-fed, 28th Oct., 1881. } 27 days.
Imago, 24th Nov., „
b, Ichneumonised specimen.

The caterpillar attaches itself by the tail and a loop round the thorax to the trunk of a tree or the coping of a wall, &c., for pupation.

Imago. Full-fed, 28th Oct., 1881.
Imago, 24th Nov., ,, 27 days.

The butterfly appears about four weeks after pupation. Though the caterpillar is difficult to obtain, owing to the rarity of the food-plant, the butterfly is by no means rare. It is, in fact, very plentiful at certain seasons of the year.

LXXXIII.—Papilio Protodamas.

Papilio Protodamas, Boisd. Spec. Gen. Lep., p. 322 (1836).

Larva. Not preserved.

I took this caterpillar in the forest on the Serra da Cantareira in January, 1882. It very closely resembles No. LXXVII, but is of a paler colour. It feeds upon a species of Aristolochia (not the same as the food-plant of No. LXXVII).

Pupa. Full-fed, 22nd January, 1882.
Imago, 15th February, ,, 24 days.

The caterpillar attaches itself by the tail and a loop round the thorax to the surface selected by it on which to undergo pupation.

Imago. Full-fed, 22nd January, 1882.
Imago, 15th February, ,, 24 days.

This butterfly seems to be a forest species, and is rarely met with in the open plain, where its close ally (No. LXXVII) *Papilio Polydamas* delights to sport.

HETEROCERA.

Family SPHINGIDÆ.

Genus PHILAMPELUS. Harris.

XCV.—PHILAMPELUS VITIS.

Sphinx vitis, Linn. Mus. Ulr., p. 354 (1764).
Sphinx fasciatus, Sulzer, Gesch. Ins., pl. 20, fig. 1 (1776).

LARVA. { *a*, Penultimate stage.
b, Last stage, not full-fed.

The caterpillar feeds upon a species of *Jussiæa* that grows in marshes and at the sides of streams. It has a large yellow flower, something like an evening primrose. In its earlier stages the caterpillar is green, with the characteristic diagonal markings of the Sphingidæ; but after the last change of skin the colouring undergoes a remarkable change, the markings being very intricate and the general colour a rich madder brown. It is very subject to attacks of an ichneumon. Out of some twenty specimens I only succeeded in rearing three moths, the rest being all ichneumonized.

PUPA. Not preserved.

The caterpillar enters the ground to undergo pupation.

IMAGO. { Full-fed, San Paulo, 7th Jan., 1882. } 30 days.
Imago, 6th Feb., ,,

The moth appears a month after the caterpillar enters the ground.

V.—PHILAMPELUS ANCHEMOLUS.

Sphinx Anchemolus, Cramer, Pap. Exot. iii., pl. 224, fig c. (1782).

LARVA. Not preserved.

The caterpillar of this species feeds on the grape-vine. I only took one specimen of the larva, and having worked it through to the perfect insect, am unable to place it in the collection. This specimen I took near San Paulo, on 21st December, 1877. It was five inches in length, and about three-quarters of an inch thick. There was no horn on the last segment, only a slight hump. The colour is green, thickly peppered over with very minute black dots.

Pupa. Full-fed, 23rd December, 1877.
Imago, 5th February, 1878. 44 days.

When full-fed the caterpillar changes to a smoky brown colour, and enters the ground for pupation.

Imago. ♂ Full-fed, 23rd December, 1877.
Imago, 5th February, 1878. 44 days.

The magnificent moth appeared about six weeks after the caterpillar was full-fed.

Genus Amphonyx. Poey.

LXXXV.—Amphonyx Tapayusa, n. sp.

Amphonyx Tapayusa, n. sp. Forewing hoary, rusty tinted; with a whitish basal spot, two sub-basal transverse zigzag slender white bands, the interspace between which is numerously black-scaled, two medial transverse inwardly oblique zigzag black bands, and four discal similar bands; from the outer discal band, near its upper end, is a black zigzag line curving to the apex; a black streak also extends from the inner middle band between the two upper median veins to the outer discal band; the interspaces between the submedian and lower median veins to the outer discal black band, and between the two discal bands to the costal end, as well as broadly along the upper median vein, are of a paler rusty colour; the remaining interspace between the two lower medians and the upper median and subcostal is greyish; the outer border of the wing is also indistinctly traversed by whitish zigzag marks, and there is a distinct white spot at end of the cell. Hindwing with a large basal orange-yellow spot and broad black costal and marginal band, the discal area being semitransparent and traversed by black veins. Body, hoary; tegulæ bordered by black; abdomen with a lateral black line and four upper lateral spots, the anterior spot being white and the others yellow. Expanse 6¼ inches. Allied to *A. Duponchellii.*—F. Moore.

LARVA. Full-fed, San Paulo, Feb., 1881.

The caterpillar of this magnificent species feeds on the Araticú (Rollinia?), and is by no means uncommon from February to May. It is of a bright green colour. There is a purplish horn, with a rough warty surface, on the eleventh segment, and a white diagonal stripe runs from the base of the horn to the ninth segment. When full-fed the colour becomes somewhat paler and duller. When annoyed this caterpillar has a habit of flinging its head round and striking the offending object. It also often bends itself backwards into a horse-shoe, holding on to the twig by its anal and last pair of abdominal legs. It prefers the leaves at the ends of the twigs for food, and hides amongst the untouched leaves lower down, where it is not easily detected, owing to its green colour. I have generally found it by observing the bare twigs and searching amongst the leaves. (See Plate VII, fig. 1.)

PUPA. Full-fed, April, 1882.

When full-fed the caterpillar enters the ground for pupation.

IMAGO. {Full-fed, 13th Feb., 1881.
Imago, 7th April, 1881.} 54 days.

The moth emerges about two months after the caterpillar enters the ground.

Family ZYGÆNIDÆ.

Genus SAURITA. Boisd.

XIV.—SAURITA CASSANDRA.

Sphinx Cassandra, Linn. Syst. Nat. ii., p. 806 (1767).

LARVA. Not preserved.

I found only one specimen of this caterpillar in the woods near San Paulo, in the middle of March, 1878. It is short and stumpy, and is thickly covered with velvety hairs that give it a beautiful glossy appearance.

PUPA. a, Full-fed, 14th March, 1878
Imago, 30th March, 1878. 16 days.

On March 14th, the caterpillar began to spin, or rather to build, its very beautiful cocoon, which it did in a very remarkable manner. Choosing a spot on the wall of my room, it began by plucking itself and laying the hairs round it in an oval shape, attaching them to the wall with gum. Then another layer was laid on the first, and so on, building up the cocoon in the most workmanlike way. It was a wonderful sight to watch the little creature lay the hairs down so symmetrically, first on one side and then on the other, building a house out of its cast-off clothes. The hairs are very beautiful under the microscope, being barbed all the way up, the barbs being so long and fine as to give the appearance of feathers.

IMAGO. a, Full-fed, 14th March, 1878.
Imago, 30th March, 1878. 16 days.

The moth emerged on March 30th. It is a beautiful insect, the wings being black and the body glistening with scarlet and blue.

Family NOTODONTIDÆ.

Genus ANEUROCAMPA. Boisd.

XCIII.—ANEUROCAMPA MINGENS.

Aneurocampa Mingens, Boisd. H.Sch. Lep. Exot., pl. 18, f. 83.

LARVA. Full-fed. 22nd April, 1881.

This remarkable caterpillar feeds upon a species of Melastoma. I have taken it full-fed in December and in April.

The colour is bright green. A white line passes down each side, above the stigmata, from the fourth to the tenth segment, and there is a crimson band, bordered on the front with pale blue, across the thorax. The eleventh segment is ornamented with bright yellow swellings, which the caterpillar has the power of puffing out and making very conspicuous. This brilliant colouring is a good illustration, as pointed out to me by Professor Herdman, of the theory that it is really a protection to the caterpillar to be conspicuous; for this caterpillar possesses the remarkable power of ejecting from its mouth a fine jet of acid fluid upon any enemy that attacks it. This fluid has a very pungent smell, and, I should imagine, would be quite sufficient to make any bird drop the caterpillar. And, no doubt, in time the birds would learn not to attack so objectionable a mouthful, and so the caterpillar would not run the risk of being damaged by their beaks. The amount of fluid discharged is equal to a good-sized drop, and it can be repeated several times, though it takes a good deal of irritation to cause a second or third discharge. The precision with which the jet is directed upon the offending object is remarkable. I have tested the acidity of the fluid with blue litmus, which was immediately reddened. (See Plate VII, fig. 2.)

Pupa.	Full-fed, 22nd April, 1881. Imago, 2nd Nov. ,,	194 days.

When full-fed, the caterpillar spins a gummy cocoon on the surface of the ground, and attaches to the cocoon leaves, bits of earth, etc. On breaking open a cocoon in August, I found the insect still in the larval condition. Pupation took place in September, five months after the caterpillar was full-fed.

Imago.	Full-fed, 22nd April, 1881. Imago, 2nd Nov., ,,	194 days.

The moth appeared at the beginning of November, more than six months after the caterpillar was full-fed.

Family PSYCHIDÆ.

LVIII.—Genus ——— ?

LARVA.
- *a*, Full-fed, San Paulo, 1882.
- *b*, Larva cases.
- *c*, Web spun by larva when walking over a smooth surface.

This remarkable caterpillar makes a tapering, conical, almost cylindrical case, in which it spends its life, never under any circumstances leaving this case. It feeds on a variety of plants, and I have found it in great numbers on a species of Mimosa. The case is quite smooth, and without any sticks or bits of leaf, which are employed by most species of this group which have come under my notice.

The caterpillar often lets itself down by a thread when it wants to move to new feeding-ground. The feeding of all the species of this group that I have observed, appears to be very irregular and intermittent. The caterpillars will sometimes secure themselves temporarily by binding the mouth of the case to a twig or a leaf, and remain for several days, or even weeks, without eating; then they unfasten themselves, and move about and eat. They are full-fed about December, I fancy; but the exact date is very difficult to ascertain, owing to the above habit of intermittent feeding. The appearance of the caterpillar when walking with the case hanging down from the leaf, and the way in which he suddenly draws the case over his head, and shuts tight the baggy mouth, when disturbed, are very comical.

PUPA. Pupation takes place within the case.

IMAGO. { ♂ Not preserved.
♀ Preserved in spirit, March, 1880.

The female moth is wingless, legless, and mouthless, and is, in fact, almost nothing more than a living bag of eggs. The male is of a dull brown colour, with a long abdomen, and the wings are narrow and long, and almost devoid of scales at the tips. Unfortunately, I am not quite certain as to the identity of the specimens I have, two species having been mixed together; so I delay placing the male in the collection until some future date, when I hope to procure males of whose identity there can be no doubt.

The female does not leave the case when she emerges from the pupa, but is fertilised, and lays her eggs in the empty pupa-shell, and for some time after laying the eggs she still remains in the case. On March 13th, 1880, I found several specimens that had left their cases, that were hanging up in my room. They had laid all their eggs, and were mere bags distended with air, and they rolled about on the table in a helpless way, reminding me forcibly of maggots. The skin was blown quite tight, like a bladder, and the tracheæ could be traced beautifully through the thin integument. To see whether there was anything but air inside the animal, I placed one of them under bisulphide of carbon fumes for a minute or two, and when dead, as I thought, I punctured the abdomen. A slight pressure forced the air out of the insect, and it became a wretched shrivelled-up bit of skin. I then introduced a pipette, and blew the skin out again. But, to my astonishment, after all this, the effects of the bisulphide passed off, and the moth revived, apparently none the worse for the operation.

On cutting open one of the cases that the moths had left, I found the pupa-shell full of already hatched larva. The effect was most wonderful. I slit the pupa-case open a little, and the tiny caterpillars came pouring out in myriads. In another case I cut open, I found the female moth still inside alive, below the pupa skin, which was full of young caterpillars, and she was distended with air, as the other specimens.

Family Saturniidæ.

Genus Automeris. Hübner.

XXVI.—Automeris illustris.

Hyperchiria illustris, Walker, Catal. Lep. Het. Brit. Mus., vi., p. 1285 (1855).

Larva. Not preserved.

This caterpillar is a very beautiful one. It is about three and a half inches in length when full-fed, and is bright green in colour. It is covered with long tree-like tufts of yellowish green spines, which are very venomous, and has a small light blue spot at the stigmata.

Pupa. { *a*, Full-fed, San Paulo, 20th Feb., 1878. } 107 days.
Imago, 7th June, ,,

This caterpillar changes to the pupa condition within a slight cocoon spun amongst leaves.

Imago. { *a*, ♂ Full-fed, 20th Feb., 1878. } 107 days.
Imago, 7th June, ,,
b, ♀

The moth emerged at the beginning of June.

XVIII.—Automeris ophthalmica, n. sp.

Automeris ophthalmica, n. sp.—Female. Dull cinnamon-red; forewing with an antemedial transverse indistinct narrow black zigzag line, and a distinct black oblique postmedial nearly straight line terminating at the apex; at the end of the cell is a large irregular angulated black-bordered mark; crossing the upper part of the disc is an indistinct darker red fascia, and there is a very indistinct pale zigzag line traversing the submargin. Hindwing brighter coloured, the outer border and cilia being pale cinnamon-yellow; on the centre of the wing is a very large black ocellus, with a narrow pale yellow outer border, and a yellow-margined broad curved brown central spot, traversed by a slender white angular line; beyond the ocellus is a narrow black discal wavy line. Sides of thorax bordered with yellow. Expanse 4⅛ inches.—F. MOORE.

LARVA. Not preserved.

I found only one specimen of this caterpillar, feeding on a species of Iris, near San Paulo, at the beginning of December, 1877. When full-fed it was three inches and a half in length. The body is of a deep black colour, and is covered with long tufts of venomous spines, which are of a rich chestnut colour near the body, and black at the tips. When irritated, the caterpillar made a curious clicking sound, apparently with the mandibles. (See Plate VII, fig. 3).

PUPA. { *a*, Full-fed, 18th Dec., 1877. }
Imago, 16th April, 1878. } 119 days.

The caterpillar began to spin on December 18th. The cocoon is slight, and is spun between the leaves of the food-plant. While in the pupa state the insect from time to time gave a series of violent shakes and twistings within the cocoon.

IMAGO. { *a*, ♀ Full-fed, 18th Dec., 1877. }
Imago, 16th April, 1878. } 119 days.

The beautiful moth emerged on April 16th.

Genus ATTACUS. Linn.

C.—ATTACUS ARETHUSIA.

Attacus Arethusia, Walker, Catal. Lep. Het. Brit. Mus., v., p. 1204 (1855).

LARVA. { Taken from newly-spun cocoon, Theresopolis,
Organ-Mountains, 16th Nov., 1882.

The caterpillar apparently feeds upon a tree called by the Brazilians, Herva de lagarto, for I found great numbers of cocoons surrounding a tree of this species. But, unfortunately, I did not find a single caterpillar that had not begun to spin, and therefore am not certain of the food-plant.

PUPA. Full-fed, Theresopolis, (about) 16th Nov., 1882.
Imago, on my return to Liverpool, Feb. to April, 1883.

The cocoons were spun on twigs of the low shrubs about the tree on which, I imagine, the caterpillars feed. The silk was spun a good way down the twig, to strengthen it in case of accident.

IMAGO.
a, ♂ Full-fed, 16th Nov., 1882.
Imago, Feb., 1883.
b, ♀ Full-fed, 16th Nov., 1882.
Imago, Feb., 1883.

The moths began to appear in January, but the greater part of them emerged in February, and five out of about twenty pupæ delayed their exit until the middle of April, one not having yet made its appearance in the perfect state. Many of the moths were deformed, owing probably to their being shaken and disturbed by their journey while pupating. Several of the moths had got turned end for end in the cocoons, and were unable to make their exit. This was also, most likely, owing to the fact of the cocoons being shaken about while the insect was still in the larval condition, and, perhaps, in an inverted position when pupation took place; for, of course, the pupa itself could not possibly reverse its position in the cocoon.

LXVII.—Attacus Jacobææ.

Attacus Jacobææ, Walker, Catal. Lep. Het. Brit. Mus. v., p. 1211 (1855).

Ova.

The eggs are laid in rows, and there are from six to nine in a cluster. I have not determined the time of incubation.

Larva. Not preserved.

The caterpillar feeds upon several different plants, and I have taken it full-fed in October and February. In the earlier stages it is of a yellowish colour, and the spines black. When full-fed it is bright green, with a white diagonal stripe on all the segments from the fourth to the eleventh, inclusive. The stigmata are black. The spines are light blue, and very minute. There is a red patch at each side of the anal legs. (See Plate VII, Fig. 4.)

Pupa. { Full-fed. San Paulo, 28th Oct., 1879. } 36 days.
Imago. 3rd Dec., ,,

When full-fed the caterpillar spins a white silken cocoon on a stalk of grass or other suitable plant, and in this undergoes pupation.

Imago. { *a*, ♂ San Paulo, 1879.
b, ♀ Full-fed, 28th Oct., 1879. } 36 days.
Imago, 3rd Dec. ,,

The beautiful moth appears about five weeks after the caterpillar is full-fed.

Family Lasiocampidæ.

Genus Syssisphinx. Hübner.

XLIV.—Syssisphinx Molina.

Phalæna Molina, Cramer, Pap. Exot. iv., pl. 302, fig. E. F.

Larva. Not preserved.

I took one specimen of this caterpillar full-fed and walking on the ground, near San Paulo, on the 4th of March, 1879. It was green, and had four curious curved horns on the thorax.

Pupa. Not preserved.

The same day that I found the caterpillar it entered the ground for pupation.

Imago.
a, ♂ Full-fed, San Paulo, 4th March, 1879.
Imago, 3rd April, 1879. } 29 days.
b, ♀ San Paulo, April, 1882.

The moth appeared a month after the larva entered the ground.

Genus Mesotages. H. Sch.

XC.—Mesotages trilunula.

M. trilunula, H. Sch. Lep. Exot., pl. 81, f. 465.

Larva. Full-fed, March, 1881.

This remarkable caterpillar feeds on several kinds of grass, and also some kinds of "taquara," or native bamboo. It is covered with curious mossy hair, of a golden brown colour. The ends of the hairs are many of them flattened out like an oar.

Pupa.
Full-fed, 15th March, 1881.
Imago, 19th April, ,, } 35 days.

When full-fed the caterpillar spins a cocoon of silk and its own hairs, weaving the hairs into the fabric, and making the cocoon look remarkably like the caterpillar itself.

Imago.
Full-fed, 15th March, 1881.
Imago, 19th April ,, } 35 days.

The moth appears five weeks after the caterpillar is full-fed.

XXXIX.—MEGALOPYGE FULIGINOSA, n. sp.

Megalopyge fuliginosa, n. sp.—Female. Dull fuliginous-brown, semi-diaphanous; forewing with an indistinct ochreous-grey spot at end of the cell, and a transverse submarginal slightly-waved band. Body olivaceous ferruginous-brown; antennæ white; front of head, palpi, and legs blackish. Expanse 2⅝ inches.—F. MOORE.

LARVA. Full-fed. San Paulo, March, 1881.

The caterpillar feeds on the Guava. It is very short and fat, and is covered with feathery hairs, black, white, and chestnut colour, beautifully blended. At the roots of the hairs are clusters of venomous spines with powerful urticating properties.

PUPA. Not preserved.

Pupation takes place within a tough cocoon, with a "trap-door" at the anterior end, which is flattened and carinated. It is surrounded by a thickly woven web, in which the hairs of the caterpillar are mixed. When the moth emerges, the skin of the pupa is left protruding from the orifice.

IMAGO. { *a*, ♀ Full-fed, March, 1878.
Imago, January, 1879.
b, ♀ January, 1879.

The moth appears ten months after the caterpillar is full-fed.

Genus HYLERIA. Hübner.

LXIV.—HYLERIA FALCIFERA.

H. falcifera, Hübner, Samml. Exot. Schmett. ii., i., f. 1-4.

LARVA. Full-fed. San Paulo, 24th February, 1880.

The caterpillar feeds on a species of Mimosa that is common, and often used for hedges near San Paulo. It is social in its habits, remaining in large clusters in a loosely spun web during the day, and separating to feed at night.

Pupa. Not preserved.

Pupation takes place within a gummy cocoon surrounded by a soft woolly web, and in their natural state probably the whole brood spin together in one mass, as I have found the broods of allied species in just such masses.

Imago. {Full-fed, 24th February, 1880. / Imago, 11th April, ,, } 46 days.

The moth appears between six and seven weeks after the caterpillar is full-fed.

Family TINEIDÆ.

Genus ENDROSIS. Hübner.

XCVII.—ENDROSIS BRAZILIENSIS, n. sp.

ENDROSIS BRAZILIENSIS, n. sp.—Forewing pale brownish-white, numerously covered with dark-brown scales, these brown scales forming a dark dentate streak at base of the cell, a small spot in middle of the cell, a similar spot beneath it below the cell, an irregular broadish transverse streak at end of the cell, and a streak along each vein towards extreme outer margin, these vein streaks being transversely confluent and thus form a series of pale oval marginal spaces; cilia pale brown, with dark brown spots. Hind-wing ashy-grey; cilia pale brown. Head and thorax pale brownish-white, thickly interspersed with brown scales; abdomen brownish, naked; antennæ and palpi pale brown; forelegs blackish above, with pale tarsal bands; midlegs and hindlegs pale brown; middle tibia and tarsi with blackish bands; hind tarsi with blackish bands. Expanse, $\frac{5}{10}$ to $\frac{6}{10}$ inch.—F. MOORE.

Larva. {*a*, Full-fed, San Paulo, June, 1882. / *b*, Long tubes formed by larvæ on dead bark.

This caterpillar was taken on the posts of my "rancho," at the Cantareira Waterworks, San Paulo, in May, 1882. It lives in a small chamber excavated in the dead bark of a tree, and from the mouth of this chamber it forms a long tube of silk and minute particles of bark. The tube is very soft and flexible, and the free end is very loose and baggy, forming an excellent covering for the caterpillar when feeding. When the caterpillar is full-fed the tube is eleven centimetres in length, the diameter at the end attached to the bark is a little over a millimetre, and the free end between two and three millimetres. The caterpillar itself is only twelve millimetres in length when full-fed. It never leaves the tube, and is very timid, darting with wonderful rapidity into the chamber in the bark upon the least alarm. The head and first segment of the caterpillar are shiny black, the rest of the body being a dull semitransparent drab. The free end of the tube is generally lightly secured to the surface of the bark, so that when the caterpillar retreats into the bark, the end is not blown away from the surface. I tried some experiments to see whether the caterpillar could in any way reach the bark from the open end of the tube, in case it should be blown loose. I raised the tubes about halfway down by bits of paper, leaving the mouths from half an inch to an inch from the surface. After a short time those that were only raised half an inch had attached themselves to the bark. As the caterpillar emerged from the chamber in the bark, and moved along the tube, the latter curved slightly inwards, so that the caterpillar was able when he reached the end to catch the surface with his legs, and draw the tube down to the bark. The curvature of the tube was so distinct that it suggested the idea of its being done intentionally, by the caterpillar pulling together the threads of the side of the tube next the bark; but I am inclined to think it was in reality only the effect of the weight of the caterpillar as he advanced. In those cases in which the tubes were raised three-quarters of an inch and an inch, the caterpillars failed to reach the surface of the bark. It is probable that the end of a tube very seldom does become loosened from the bark, and in case such an accident should happen, the caterpillar waits till the wind blows it against the bark, where the loosely woven fabric is very likely to catch.